FOUNDRY TRADE JOURNAL

Established 1902

Vol. 94 Thursday, February 12, 1953 No. 1902

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PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s., Abroad 45s. (Prepaid).

49 Wellington Street, London, W.C.2. 'Phone : Temple Bar 3951 (Private Branch Exchange) Grams : "Zacatecas, Rand, London"

Shell-moulding in America

The annual review number of the *Iron Age* contains a most interesting survey of the progress and prospects of the shell-moulding process in America and the figures we shall refer to are from this source. Initially, it is stated that no fewer than 150 foundries are "testing or producing." A battle is already being waged on costs, as those for shell-moulding are often higher than the original estimate. Wisely, it is pointed out that shell-moulding will supplement rather than replace conventional foundry techniques. During the year, there has been a growth in the maximum size of casting to which the new process is applicable. It has grown from the 20 to 30 lb. range up to 200 lb. For these heavier castings, patternplates up to 30 by 45 in. are available in the new automatic mould-making machinery.

Throughout the article, there are examples given of the "precision" nature of the process and the advantages to be had from reduced fettling and machining costs. There are benefits to be derived from the reduction in gates and risers and chills, especially in the direction of metal weight reduction. A rather surprising statement is that the "reduction in pattern equipment, which this makes possible, may in itself present a substantial saving in foundry costs." Apparently it does not mean that the actual patterns are cheap. Then there are comments on drawbacks. An obvious one is that the slower cooling to be associated with shell-moulding throws a coarser grain structure. The thicker shell moulds—that is more than ¼ in.—may yield a rougher surface. Ferro-static pressure can cause some mould spread, but against this there are no mis-matches. The new machines available to the industry are costly and so far have not reached perfection.

It seems that the new process is well suited for the production of nodular iron, and now castings weighing up to one hundredweight are in regular production. One plant, on an experimental turntable machine, produces 75 moulds during an eight-hour shift, and when fully developed the unit is expected to produce daily 45 tons of castings. An interesting statement which needs stressing is that in the excitement over shell-moulding, the possibilities of "shell" cores have been overlooked; their cost is thought to be quite favourable. An important factor recorded in this article which we are quoting from is the divorce of pouring from mould production made possible through the reduced volume of the sand mould and its permanent character, which renders storage quite practicable. This makes the process of outstanding appeal to the steel-founder. In the article, there is included a list of plants which have installed or are installing continuous casting machines; in this list are names of two English firms. Curiously enough, of the 17 firms included, not one is engaged on cast iron! Finally, we congratulate the writer of the article on presenting such an interesting survey, which demands so little comment.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

IRON AND STEEL BILL

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Ironfounders who registered their votes in the national ballot conducted by Price, Waterhouse & Company will no doubt be expecting to learn what action has been taken by the sponsors, following publication of the result, which showed an overwhelming majority of founders as opposed to the inclusion of iron foundries in the Bill.

The reports which appeared throughout the Press on January 14 on the meeting held on the previous day between the Minister of Supply and some of the leading trade associations, have led to a widespread belief that all opposition to the Bill was to be discontinued, and that all differences between the Minister and the industry had been amicably resolved.

The fact of the matter is that the British Steel Founders' Association and representatives of the engineering industry attending such meeting maintained their view that foundries should be excluded from the Bill, which was clear from the relevant "Press release" agreed to by the Minister at the end of the meeting, the result of this being a widespread misunderstanding concerning the real issue involved. At the meeting with the Minister on January 13, the unanimous conclusion was reached that, short of excluding the foundries from the Bill, the Government's revised proposals would remove as far as possible existing anxieties and objections. It is necessary to point out, however, that this conclusion was in fact reached before the majority opinion of those directly affected was known.

The sponsors of the ballot held a meeting in Birmingham on January 22, at which an overwhelming majority of those present considered it their clear responsibility to continue to press for the complete exclusion of iron foundries from the Bill and a sub-committee was elected for this purpose.

It is submitted that the reasons why 93 per cent. of the votes cast in the ballot opposed inclusion in the Bill may be summarized as follows: (1) A belief in the principle of freedom for the foundry industry as opposed to control under a Government-sponsored Board; (2) The ironfounding industry is not a part of the iron and steel industry, but part of the engineering industry; (3) The true relationship between the ironfounding industry and the iron and steel industry is clearly that of consumer to producer; (4) The illogical nature of all the reasons given for including ironfounders in the Bill; (5) The inability to accept the contention that increased controls and supervision over the industry are necessary; (6) The conviction that inclusion will not result in a single extra ton of iron castings produced, and can only be expected to add to the cost of production, and (7) The political considerations and attendant dangers involved.

Many have been quick to claim credit for the large number of amendments tabled, but when these are regarded calmly and critically, it soon becomes apparent that very little ground has been gained, and in some instances setbacks have been suffered. There is still a large volume of opinion which is apparently disappointed in developments, and still strongly opposed to ironfounders being placed under the purview of the proposed Iron and Steel Board.

If this letter helps to reassure ironfounders that they have not been left in the lurch by those who had the courage to sound them for their opinion, it will have served its purpose. Certain steps have already been taken in support of the mandate received from the industry, and ironfounders have our assurance that resistance to this unpopular and pointless experiment with their highly progressive industry will be continued with unbowed spirit and unabated energy, in whatever direction may be indicated.—Yours, etc.,

W. STRINGER-JONES (*chairman*) (Jones & Attwood, Ltd.)
H. DESMOND CARTER (Crossley Bros., Limited)
CHARLES H. CRABTREE (Crabtree Foundry Co., Ltd.)
JOHN GREAVES (Davey, Paxman & Company, Limited)
(Members of Foundry Ballot Sub-committee.)

Iron and Steel Bill

Further Deliberations in Committee

During the week, several Government amendments were introduced into consideration of the Iron and Steel Bill, now at the Committee stage in Parliament. Most of these related to minor changes of wording, for instance, on Friday, the Minister proposed to amend Clause 31 (page 26 of the Bill) from line six "producers . . . ." to the end of line seven, to read "of workers employed in the iron and steel industry, of persons using iron and steel products for manufacturing purposes or engaged in the merchanting of such products, of workers employed in the undertakings of such persons, or of any class of such producers, workers or persons as aforesaid." This relates to the interpretation of "representative organizations" as used in the general framework of the Bill.

Then, on Monday, the Minister moved the following clause relating to the application of price provisions to castings and forgings:—

"(1) Section seven of this Act shall not apply to any products of an activity included in paragraph 4 or paragraph 6* of the Third Schedule unless the Board have made a report to the Minister under the following provisions of this section and the Minister has made an order under those provisions directing that the said section seven is to apply to those products.

(2) If the Board consider, as respects any class of products of any such activity (*a*) that at least one-third by weight of the total annual output in Great Britain of products of that class is being produced by any one person, or by two or more persons, being interconnected bodies corporate within the meaning of the Monopolies and Restrictive Practices (Inquiry and Control) Act, 1948; or (*b*) that the producers of at least one-third by weight of the total annual output in Great Britain of products of that class whether voluntarily or not, and whether by agreement or arrangement or not, so conduct their respective affairs as in any way to prevent or restrict competition in connection with the supply of those products, the Board may, by notice served on the producers of those products in Great Britain, require them to satisfy the Board, within three months from the date of the service of the notice, that the prices charged by them for those products are reasonable, or that they have taken steps to reduce those prices to a reasonable level.

(3) If the producers on whom a notice is served under the last preceding subsection fail to satisfy the Board of the matters aforesaid in accordance with the notice, and the Board make a report to that effect to the Minister, the Minister may, after consultation with such representative organizations as he considers appropriate, by order direct that section seven of this Act shall apply to the class of products to which the notice related."

* Where the activities of iron and steel casting and forging covered by the Bill are listed.

Hadfields' Furnace Installation

Considerable courage was shown by Hadfields Limited and Birlec Limited when they invited representatives of the technical Press to inspect a 20-ton electric melting furnace installation which was put into commission but a few days ago. The teething troubles have been at a minimum and the initial performance is excellent, as heats are being taken out with a current consumption slightly between 500 and 600 units per ton. The only fault detectable in the design is the provision of only one position for placing a bar across which to pose the tools during furnace operation. This feature is to have attention.

The Birlec Lectromelt furnace (Fig. 1) is located between two bays—the crane system in one handling the charging operations, and the other crane system servicing the ladle. The installation of this furnace involved the complete erection of a melting shop, including two 40-ton electric overhead gantry cranes for steelworks service, with 10-ton auxiliary hoists, an 18-ft. 10-in. deep pouring pit, an ingot casting pit, a pit to contain the scrap charging bucket, the necessary house for the transformer, "Amplidynes" (automatic electrode control gear) and electrical switchgear, and the electrode winch gear. This furnace is used for the production of high-quality steels and is normally operated continuously.

Birlec Lectromelt Furnace

The Birlec Lectromelt steel-melting furnace conforms generally with the established characteristics of direct-arc furnace design, gradually developed over the past 50 years. It is based on the designs of the American Pittsburgh Lectromelt Corporation which probably has more experience of building large arc furnaces than any other organization in the world. Lectromelt equipment is distinguished by extreme sturdiness in construction and by a number of design features which will be dealt with in the following description. Lectromelt equipment is supplied in Great Britain, the British Empire and many other countries by Birlec Limited.

Shell

The shell is cylindrical in shape with a dished bottom. Its shell diameter of approximately 14 ft. 0 in. and other leading dimensions ensure that the furnace provides a large slag contact area. It is constructed of heavy gauge steel plates reinforced with structural steel members and, to prevent distortion of the shell under heat, a heavy top stiffening water-cooled bezel ring is provided.

Two door openings are provided in the shell, one opposite the pouring spout and the other at 90 deg. to this diameter opposite the electrode masts. The former door is used for slagging, oxygen lancing, fettling and other operations, and the latter for making alloy additions to the melt. The door openings are provided with vertically sliding doors, running in accurate guides and operated by push-button pneumatic control. A robust pouring spout is attached to suitable reinforcements on the shell. As with the doors, the spout is designed for easy refractory lining. The shell is lined with metal-cased magnesite tubes (Fig. 2).

Roof

Two roof rings are provided with the furnace; they are constructed of heavy, channel section steel and are built to a larger diameter than the furnace shell. This important point ensures that the skew-back bricks are removed from the heat of the molten metal and greatly increases their life. The roof ring is also water cooled, thus reducing the risk of distortion.

The roof is suspended at four points from two structural steel beams—an arrangement known as "four-point roof suspension" which, in this installation, is incorporated for the first time on a 20-ton arc furnace. This arrangement greatly facilitates roof change as the replaced roof can be quickly removed by unfastening the four holding screws and the new one easily located in the correct position. No trouble arises with the alignment of the electrode ports and the electrodes.

Roof Lift Mechanism

The most notable design particular on this furnace is the lift and swing-aside roof, which enables the complete hearth to be exposed for re-loading or fettling. The complete furnace roof structure, suspended from the two parallel beams, is secured in a massive eye-casting, itself weighing over 10 tons.

The "eye" in this casting engages in a vertical ram, operated by oil pressure. The complete ram cylinder is mounted entirely separately from the furnace body, a patented Birlec Lectromelt design feature. This separate mounting means that the furnace shell is not subjected to severe stresses when the roof is lifted and also prevents the formation of a hot spot on the cylindrical body, through impediment to uniform heat dissipation.

The swing-aside roof arrangement enables the furnace to be top-charged. The roof is raised from the shell by the ram engaging in the eye-casting and lifting it clear. The complete roof structure is then swung round sufficiently to expose the hearth; that is, to almost 90 deg. The drop-bottom bucket is then lowered into the shell and the charge loaded. A tightly-packed charge enables the furnace to hold 20 tons without re-charging. As the bucket is swung clear the roof returns to its original position and is lowered on to the shell. All phases of the roof lift and swing mechanism are interlocked to ensure correct sequence of operation and to prevent the tilting of the furnace except when the roof is in the working position, or lifting the roof when the furnace is tilted.

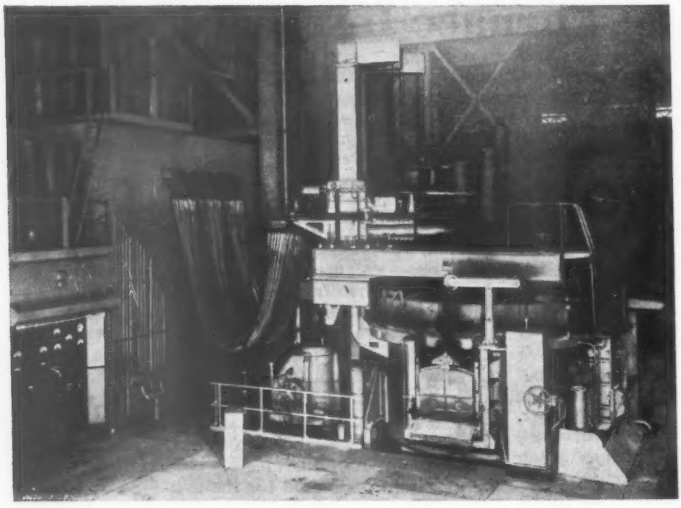


FIG. 1.—*General Arrangement of the New 20-ton Furnace Installation with Transformer House and Control Panel on left.*

Tilting Mechanism

The furnace is tilted by means of steel rocker trunnions gearing into horizontal tracks on either side of the shell. Here again the solid construction is noteworthy, the total weight of the tilting gear exceeding 12 tons. Another feature, adopted throughout the furnace design, is to remove all mechanism from beneath the furnace shell, thus obviating the risk of fouling or of damage due to a metal break-through. The furnace is designed for a 45-deg. tilt forward for pouring and a sufficient angle backwards for slagging. The tilting rockers are operated by a pair of oil-pressure rams mounted one each side of the furnace. Oil pressure is supplied from a self-contained motor pump unit which also serves the roof-lifting mechanism.

Electrode Gear

Three 14-in. diameter graphite electrodes, supplied by British Acheson Electrodes Limited, Sheffield, are held in high-conductivity copper clamps and project vertically through the furnace roof. The copper clamps are fitted with water-cooling passages. A special feature of the clamp design is the fitting of a pneumatic mechanism so that they can be opened and closed by remote control. This enables the electrodes to be slipped very quickly and easily when a new charge is loaded or whenever the electrode height requires adjustment. The clamps are mounted on the extremities of horizontal arms, which carry the conductors for electric power and cooling water. The arms are of rigid construction and designed to minimize eddy-current losses.

The arms are connected to the vertical masts by carriages or crossheads. The crossheads are fitted with hardened steel adjustable rollers in anti-friction bearings which engage with flat machined surfaces on the masts. Smooth up-and-down movement, without lateral play is, therefore, obtained. The electrode masts are mounted at the rear of the furnace shell in the heavy steel eye-casting which also carries the roof supporting beams. The electrode carriages are suspended on flexible steel cables passing over ball-bearing sheaves and lead through ducts in the furnace foundations to individual winches, located beneath the melting shop floor. The winches are driven, through gearing, by d.c. motors rated for frequent reversing duty. The winch drums are provided with specially-designed friction bands over which the suspension cables pass to terminate in counterweights.

Electrode Regulator

An important feature of this furnace installation is the incorporation of "Amplidyne" electrode-regulation gear manufactured by the British Thomson-Houston Company, Limited. Three

FIG. 2.—*Charging Bucket lowered over the Furnace Body after Removal of the Roof. The New Furnace is lined with Metal-cased Magnesite Bricks.*

electrode winch motors are provided, one for each electrode; they are located in a separate brick-built chamber. The "Amplidyne" is a special type of d.c. generator. The field excitation of this generator is controlled from opposed voltage and current components of the furnace power circuit and produces instantly a corresponding but greatly magnified variation in the generator voltage applied to the winch motors. Thus, the winch motors are energized in proportion to the degree of out-of-balance in the furnace power circuit and the electrodes move rapidly to compensate for large changes and proportionately more slowly for small variations. The system thus provides smooth, stepless movement of the electrodes, with maximum speed and without hunting for correcting any deviation from desired arc conditions, without the use of relays, giving maximum sensitivity and accuracy of control.

Power Equipment

The 6,000-kva. transformer has been supplied, through Birlec Limited, by C. A. Parsons & Company Limited, Newcastle-on-Tyne. It operates from a primary 11,200 volts, 50 cycles, 3-phase supply and provides eight secondary tappings. An on-load tap-change switch is provided, arranged for off-load operation. Both motor-operated, push-button control and manual control are provided. An illuminated indicator on the furnace instrument panel shows the position of the tapping switch.

The transformer tank is built from mild-steel boiler plate, suitably stiffened with steel sections. The transformer is constructed with specially-braced windings to withstand heavy current fluctuation and is conservatively rated to give a temperature rise of 50 deg. C., measured in the oil, under continuous full load. The water-cooling system is equipped with a temperature alarm device to warn the operator immediately of an unsafe oil temperature. The main switch was supplied by A. Reyrolle & Company Limited, Hebburn-on-Tyne, through Birlec Limited. It is a metal clad, 400 amp., compound-filled single busbar switch panel. It has a rupturing capacity of 150 mva. at 11,000 volts, 3 phase and is arranged for solenoid operation. An interlocking relay ensures that the breaker trips whenever the transformer tap charge operates or when any of the individual furnace interlocks make contact.

Controls and Metering

All controls and metering are centralized in one black Sindanyo control board. This is mounted in the wall of the transformer sub-station and is easily accessible to the working area around the furnace. It contains the necessary indicating lamps for electrode voltage and auxiliary electric supplies, the transformer tapping switch indicator, an electric clock, voltmeter and multi-point switch for electrode voltages, an ammeter for each electrode circuit, and a kw. meter to show the power applied to the furnace; it also carries the required control switches for the electrode winch motors, hand-operated rheostats for obtaining the correct arc-ing conditions and isolators for the auxiliary a.c. and d.c. supplies—for instrument operation, etc. A telephone on the board connects to the main Hadfields switchboard.

The representatives of the Press were received by Lord Dudley Gordon, chairman of Hadfields Limited, Mr. E. W. Colbeck and Mr. R. Lamb, directors, whilst the Birlec Company was headed by Mr. T. G. Tanner.

Productivity in Heavy Chemicals

Productivity in the heavy chemical industry in the United States is two or three times as great as in Britain. Yet prices in Britain are generally lower and the employees work harder. These are the main findings of an Anglo-American productivity team which has just reported on a visit to the United States.

The team found that the most modern British chemical factories were as efficient as those in the United States, but that generally the American chemical industry had a greater proportion of modern equipment. The team decided that the British industry could be improved in four ways; by improving basic processes, plant, and equipment, by reducing and standardizing the range of products, by improving methods of operation and control, and by increasing the effectiveness of the labour force. American companies averaged one technically-qualified man to every six hourly-paid workers, whereas in Britain this ratio was one in 16. An urgent need, therefore, is that manufacturers of heavy chemicals should arrange with universities and technical colleges for a rapid increase in the number of technical graduates employed. They should also provide schemes for the continuous training of all employees.

STEAM STATIONS of the British Electricity Authority consumed 1.31 lb. of coal per unit generated in 1952, compared with 1.43 lb. in 1946, according to figures given by the Minister of Fuel and Power.

Spanish Contracts Secured

All the rolling-mill equipment for the new works of Empresa Nacional Siderurgica S.A., Aviles, Asturias, Spain, will be made by Davy & United Engineering Company, Limited, Sheffield, and its subsidiaries, Davy & United Roll Foundry Limited, of Middlesbrough, and Duncan Stewart & Company, Limited, of Glasgow. When complete, the extensions to blast furnace, steel making and rolling capacity are expected to cater for an output of one and a half million tons annually.

This will be the ninth major primary mill plant built by Davy-United in the last eight years—a record unapproached by any other European rolling-mill engineers—and the third of its type obtained in an export market against determined foreign competition. Under the same project, Head, Wrightson & Company, Limited, Thornaby-on-Tees, are to supply a complete iron-ore handling plant and a blast furnace to produce 1,000 tons a day. The equipment will be designed in conjunction with the Arthur G. McKee Company, of Cleveland, Ohio, and the majority of it will be constructed in Head, Wrightson's works.

MR. WATKINSON, Parliamentary Secretary, Ministry of Labour, announced that the department was undertaking a country-wide survey of accidents caused by machines in the course of construction. When that investigation was complete, talks would be arranged with both sides of industry to discuss the introduction of suitable regulations.

Notes from the Branches

London—East Anglian Section

The December meeting of the East Anglian section of the Institute of British Foundrymen took place in the Central Library, Ipswich, on December 16, when Mr. P. G. Pentz, of Leicester, Lovell & Company, Limited, presented his paper "Synthetic-resin Corebinders." Although the attendance was below normal owing to bad weather, a lively discussion followed the paper, and at the close of the meeting a vote of thanks to the Author was proposed by Mr. D. Carrick.

The first meeting of 1953 was held on January 20, with Mr. R. J. Hart presiding. For the first part of the meeting, the French film "Avec le Feu Sacré" was shown. This film was produced in 1949 under the patronage of "La Direction de l'Enseignement Technique" (the authority for French technical education) and the *Syndicat Général des Fondeurs de France* (the French Foundry Association). The primary aim of the film was to present foundry activities in a popular form. It is directed mainly to the general public rather than the foundry technician, and should not be confused with technical instruction films. It emphasized the importance of the foundry in the national economy by showing some of its products. A short discussion followed the conclusion of the film.

The second part of the meeting consisted of a discussion amongst the general assembly of some questions left over from the last "Brains Trust" meeting. This proved to be a very enjoyable feature, and much interest was taken in the various points raised. This meeting concluded with a vote of thanks proposed by Mr. D. Carrick.

5th International Mechanical Engineering Congress

The fifth International Mechanical Engineering Congress will be held in Turin, Italy, from October 9 to 15, 1953, during the *Salone Internazional della Tecnica*, so that participants will be able to visit this important exhibition. This year the congress will be organized by the *Associazione Industriali Metallurgici Meccanici Affini* of Italy, with the support of the organizing committee, the members of which are also the mechanical engineering trade associations of Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Holland, Luxembourg, Norway, Spain, Sweden and Switzerland. The theme for this year's Congress is: "Production and Assembly Methods for Components in Mechanical Engineering." Various foundry methods, including precision casting, will be reviewed, and participants will have the opportunity of visiting a certain number of industrial undertakings in and around Turin, including the Olivetti concern.

Following the Congress there will be a study-tour from October 16 to 22. The proposed itinerary for this includes visits to large industrial undertakings in Central Italy. Those desiring further particulars of the Congress and also engineers willing to prepare papers for submission within the scope of the general theme are invited to communicate with: The British Engineers' Association, 32, Victoria Street, London, S.W.1.

ON JANUARY 31, an enrolment ceremony of the St. John's Ambulance, cadet division, was held at the cinema of the Stanton Ironworks, near Ilkeston.

Mond Nickel Fellowships

The Mond Nickel Fellowships Committee now invites applications for the award of Mond Nickel Fellowships for 1953. The main object of these Fellowships is to enable selected applicants of British nationality and educated to University degree, or equivalent standard, to obtain additional training and wider experience in industrial establishments, at home or abroad; so that, if they are subsequently employed in executive or administrative positions in the British metallurgical industries, they will be better qualified to appreciate the technological significance of research and to apply its results.

There are no age limits, though awards will seldom be made to persons over 35 years of age. Each Fellowship will occupy one full working year. It is hoped to award five Fellowships each year of an approximate value of £900 to £1,200 each. Applicants will be required to define the programme of training in respect of which they are applying for an award, as well as particulars of their education, qualifications and previous career.

Full particulars and forms of application can be obtained from the Secretary, Mond Nickel Fellowships Committee, 4, Grosvenor Gardens, London, S.W.1. Completed application forms will be required to reach the Secretary of the Committee not later than June 1, 1953.

Refresher Course for Works and Plant Engineers

The Extra-mural Department of the University of Sheffield is holding a refresher course for works and plant engineers, at the University, from April 13 to April 17. The course is planned to be of interest to engineers employed in the iron, steel and kindred industries. Lectures followed by discussions will include such subjects as, the Economics of Fuel Selection, Combustion Control, the Determination and Interpretation of Heat Balances, Compressed Air Appliances and Practice; the Design, Performance and Maintenance of Furnace Plant; Waste Heat Recovery; Works Handling Problems in Relation to Fuel Economy and Lessons of American and Continental Practice.

The fee for the course will be £2 10s. 0d. (including morning coffee, lunch and afternoon tea). Accommodation is available in one of the University halls of residence at an inclusive fee for lectures, accommodation and all means, of £6 10s. 0d. Enquiries should be made to the Director of Extra-mural Studies, University of Sheffield, St. John's, Crookes Valley Road, Sheffield, 10.

"Conveyors as Your Servants."—It may be of interest to readers to know that they can obtain, on loan, free of charge, a film recently produced by the Mechanical Handling Engineers' Association, 94/98, Petty France, London, S.W.1, under this title. The film was devised to serve as a supplement to the documentary film "Mechanical Handling," released in 1948, and indicates some of the extensive possibilities of application of mechanical means for the movement of all types of materials and goods in all industrial processes. It is a 16 mm. film, in colour, with a sound commentary, and applications for prints on loan should be made to the Association.

THE SUMMER MEETING of the Institution of Mechanical Engineers is to be held in Sheffield from July 1 to 3.

Casting Design in Relation to Production*

By J. H. Pearce, M.I.B.F., and G. D. Whitehouse, A.M.I.B.F.

In the foundry industry, much is heard about competition from weldings and fabrications. Indeed the industry must always be on the look-out to design castings which, in turn, can oust forgings and fabricated parts. Most founders are well aware that the potentialities in the casting field are tremendous, and it is becoming increasingly evident that a careful study of equipment-manufacturers' products, and the parts that go into their assembly, will reveal to casting producers, wide markets that will not only result in more business for foundries, but will supply customers with more versatile and economical parts.

All foundries are not, of course, large enough to have a design department, but even in the smallest foundries it is essential to have someone whose job it is to decide what methods are to be used in the production of castings, and what modifications can be made to ease some of the founding problems, etc. The system used in one works to tackle these problems is to have a section of the foundry known as the foundry products drawing office. This section is devoted to the design of possible castings, and has many commendable successes to its credit. The ultimate aim of all concerned is, of course, to arrive at a correct design. It is not essential that the designer be a qualified foundryman and be thoroughly versed in every aspect of foundry practice, nor is it, on the other hand, necessary for the foundryman to be a qualified designer. The common interest is the most economical production of a casting, which embodies the desired characteristics of quality and utility.

From the angle of foundry production, unsatisfactory design is responsible for many defective castings, and whilst it is admitted that relatively little data on the effect of design has so far been established and made available to engineers, it is believed that co-operation between the foundryman and the designing engineer can, and does, result in improvements whilst the design is in the formative stage. It usually evolves upon the designing engineer to take the initiative in arranging for consultation between himself and the foundryman, this being necessary to settle such matters as, taper on patterns, whether this effects the ultimate design of the casting; contraction allowances, etc. These are some of the more obvious questions which the designer has to settle. Originating in the designer's mind, therefore, the design is developed and ultimately presented to the foundry for a quotation of price. He must always keep in his mind the problem of economic production and must aim to eliminate unnecessary weight. He must not introduce modifications which neither improve the ability of the casting to withstand stresses in service, nor lower the cost of production.

Choice of Material

Naturally, one of the first things the designer asks himself is "What is my article expected to do," and no design can ever be considered satisfactory unless the casting can fulfil all the operations for which it was intended. In considering this, the designer then has to decide the material which he intends to use. With castings, he has a very wide choice, ranging from light alloys to ferrous and copper-base material. In arriving at his conclusions he has to consider whether the casting is subject to abrasion, fatigue, corrosion, compression, and must take into account all the factors which go to make a successful casting, such as machinability, if necessary, and also the ultimate appearance of the casting. He is, of course, limited by the type of melting unit which a particular foundry possesses, most foundries having their own particular metals in which they specialize.

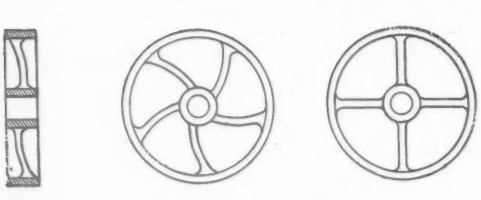
Metallurgically, designers are often not exact enough. They are generally aware that there are various grades of iron and steel, but rarely specify the exact physical requirements on a drawing, perhaps simply stating "cast-iron" or "cast-steel," "close-grained iron," or even "Meehanite." Often the definition "material to B.S. specification," is used, with no indication of the number, and, as is well known, there are several grades in the specifications from which to choose a material. If a component casting fails mechanically in service, it it quite often stated that the iron is not strong enough, and should have been made in a higher grade. This is just not good enough in cases where the physical specification has not been exactly stated. It is sometimes possible to change a design and, in particular, the metal thickness of various sections, of say, an iron casting for it to be made in cast steel, or even possibly alloy steel, and by so doing, effect a saving in weight. Metal specification has a considerable bearing on the running and feeding of castings in a mould. Each grade has its own running properties and solidification characteristics. For instance, with cast-iron, of increasing tensile strength according to B.S.S. 1452, the easy running characteristics of the metal decrease and shrinkage likelihood increases.

Features to Eliminate

Hot-tears

The occurrence of hot-tears during solidification, due to restricted contraction in the metal, is further emphasized by large temperature differences. Abrupt changes in section and sharp corners or angles contribute to such temperature differences, and these points often become the focus for crack formations to start up during cooling. Shrinkage

* Paper presented to the Scottish branch of the Institute of British Foundrymen.



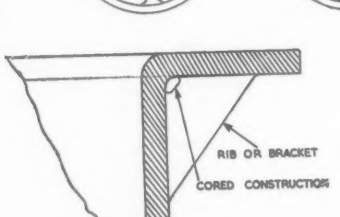


FIG. 1.—*Coring of a Bracket Web and Re-design of Wheel Spokes to Eliminate Casting Stresses*

cavities are likely to be found in sections, which, due to design, have to be fed through smaller sections. These, of course, solidify too quickly to be of adequate feeding value. The mechanical properties of the casting also vary somewhat in accordance with the mass of any particular section. Recent years have seen improvements in the methods of feeding castings, and properly arranged temperature-gradients in the means of feeding them are more common than they used to be, so that hot spots are more often eliminated, and the designer is better assured that hot metal for feeding purposes does, nowadays, reach the last portion of the casting to solidify.

Isolated Masses

A design is occasionally encountered, in which an area of heavy metal is attached on all sides by sections of much smaller thickness, and so positioned that the foundryman has no opportunity to feed the heavy section properly. Such a condition is distinctly one of poor design and should be closely investigated to ascertain if the heavy mass could be made lighter by the use of cores.

Padding

Another method of improving the feeding of castings is by the use of pads or by thickening the metal at the sections of the casting where additional feeding is necessary. This padding is mainly used at the sections where the feeder heads adjoin the metal of the casting, but it can be used anywhere to avoid abrupt changes of section. It is also used at places where heavy internal sections of metal adjoin thin webs. It sometimes takes the form of a localized and gently-shaped thicker section of metal. Naturally, the pads are not a feature of the casting design proper, and if they appear on the outside of the casting in an unsightly form, they are to be removed by chipping or grinding. On internal surfaces, they are sometimes not readily accessible and may, on occasion, be left on the finished job.

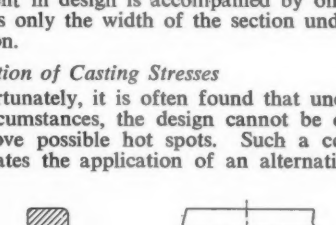
Ribs

It is often necessary to increase the strength of a casting by incorporating in the design a number of ribs for the purpose of stiffening. These should be kept to a minimum and not used indiscriminately, as they are possible sources of trouble both as regards contraction cavities and the possible formation of hot-tears. The placing of brackets across adjoining sections, of course, increases the mass effect at the intersection. This condition may be remedied by the coring of the bracket in the region of the adjoining sections, as is shown in Fig. 1. Such coring will not impair the stiffening features of the bracket, but will allow for better conditions as regards soundness and freedom from hot-tears where the rib joins the body of the casting. The spokes of a wheel of conventional design under stress might crack near the hub or near the rim. If the spokes be designed with a wave in them, they will, in stress, tend to be pulled towards the shape of a straight principal, thus evening out the stress concentration which is the cause of the tearing. This method is also shown in Fig. 1. This wave-type construction can be applied to many other designing situations and if the required stiffness can be met from a foundry viewpoint, acceptance of such a design principal provides a very useful method of stress-relieving in a closed system of integral members.

A method often used to eliminate a hot spot at a junction is to off-set the arms of the "X" section to be employed. In order to ensure that the design is considerably improved, it is necessary that the arms should be widely off-set. No improvement in design is accompanied by off-setting the arms only the width of the section under consideration.

Elimination of Casting Stresses

Unfortunately, it is often found that under certain circumstances, the design cannot be changed to remove possible hot spots. Such a condition necessitates the application of an alternative plan



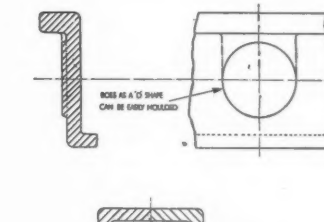


FIG. 2.—*Practical Examples of Casting Modifications; Upper Example shows the Change of a Boss to D-shape for easier Moulding; Lower Illustration shows the Turning of Beading to the Inside, where it can be Formed by the Core.*

for the prevention of hot-tears. This can be accomplished by the elimination of stresses which would be formed during the cooling of the casting, and would act on the hot spots or other points of stress centralization. These stresses are usually found at abrupt changes of section and at sharp corners. Such positions are structurally weak, and coupled also with the fact that they are usually hot spots with lower mechanical properties, it is easily seen that they are potential locations for hot-tears. If, however, liberal fillets can be placed at the corner junctions, the stress will be more evenly distributed, and hot-tear formation less likely.

Practical Examples

However much one may theorize on the design of castings it is always the practical application of theory which is essential to produce successful results. In connection with castings, no one is better able to advise than the patternmaker and the moulder. Indeed it is necessary to emphasize that young designers or draughtsmen should never be afraid to ask the opinion of practical foundry personnel on any question involving modification of casting design. They are always most helpful and ready to co-operate. For instance, it is not always possible to show on drawings every detail such as moulding taper, use of chaplets, etc., and the practical experience of craftsmen is invaluable in such matters as these. Their experience can provide many hints and tips resulting in increased efficiency in production. Two typical examples are shown in Fig. 2. The upper diagram shows a circular facing-boss on a casting, to which a simple change of shape has been made, and by so doing, the casting becomes more readily mouldable. In the original shape it would have been necessary to core-off the portion between the boss and the flange. On the same diagram, a typical section is shown through a side-member of a motor bogie frame. When making this job, it was found necessary to use a series of cores for the inside contour of the casting and a full pattern for the outside shape. Originally, the casting was designed to have the beading on the outside of the frame. This meant that the mould joint had to be positioned on the centre of the beading, leaving the remaining portion of the beading in the top half of the mould. By changing the beading to the inside shape of the casting, as shown, and still retaining the section modulus for the strengthening of the section, the beading was incorporated in the core and the pattern was left clean for a straight withdrawal and a completely flat top-half mould. By thus being able to use a flat top-half, production was speeded up and economy effected by saving in man-hours and in the cost of pattern making. These are only two examples of many modifications which can be carried out when new designs are reaching the foundry. The co-operation between drawing office and foundry floor is most effective at this stage.

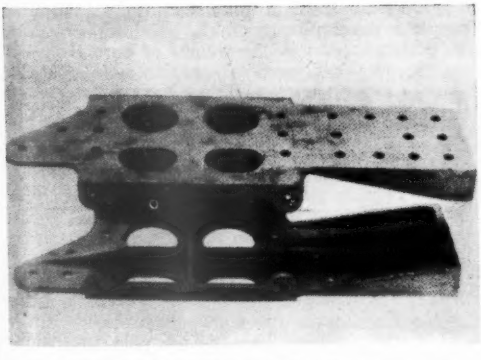


FIG. 3.—*Three-piece Centre Filler Casting as now Produced for Railway Freight Car Manufacture.*

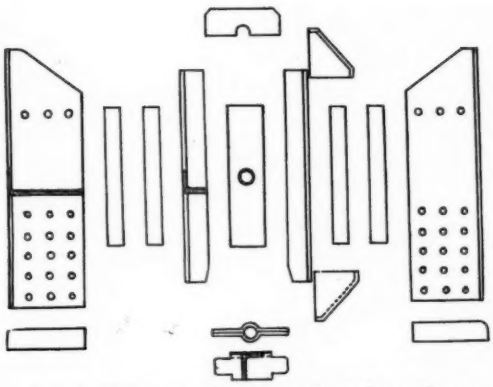


FIG. 4.—*Seventeen Component Parts for a Centre Filler to be Fabricated by Welding.*

Cast/Welded Constructions

The designer can, on occasion, aid in producing more stress-free assemblies by designing intricate castings in, say, 2, 3 or more parts with the final assembly into one complete structure by joining the various cast parts by welding or, if necessary, riveting or bolting. It should be emphasized, that the cast/welded construction is only necessary when satisfactory production as a one-piece unit is almost impossible. In certain cases, secondary heat-treatment is necessary after welding to produce a stress-free unit. Whilst the welding of castings is, unfortunately, in this country, looked upon by consulting engineers and inspectors mainly as a method of repair, it is accepted abroad as a fairly common method of producing a satisfactory unit, and is becoming increasingly popular with design engineers and casting purchasers. It is hoped that the use of cast/welded units will become more widely accepted, and that engineers will value this method of construction.

Versatility in Design

In examining the possibilities of the production of any particular casting, it is sometimes advantageous to break castings down into small units; on the other hand, improvements may be effected

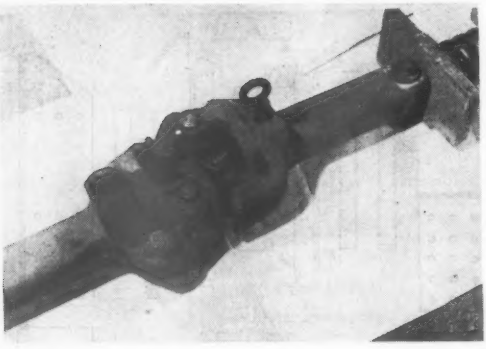


FIG. 5.—*Design of Cast Steel Couplings as frequently used Abroad for Railway Rolling Stock and now to be adopted for British Railways.*

by designing several small castings into one larger casting. No hard and fast rules can be laid down, and the method to be used must vary with the particular casting. As it seems probable that the future will see more exacting engineering products called for, which will involve either heavier loads or higher pressures and temperatures, it is opportune to mention some of the problems connected with the design of certain steel castings, and the designers view-point in relation to their production.

Cast Steel, like any other metal, has certain characteristics which are inherent and can be considered as natural phenomena. For instance, the volumetric contraction which takes place when steel transforms from the liquid to the solid is comparatively high. This means that considerable thought must be given when designing the casting, so that the contraction is compensated by an adequate supply of liquid metal. Steel, in common with certain other metals, has very low strength and ductility at temperatures immediately below the solidification temperature and, therefore, careful attention should be given to the design features with a view to reducing possible stresses acting upon the casting at this stage. Liquid steel in comparison with other metals, has poor fluidity also, and the designer should not insist on sections so thin as to cause losses from failure to run, or to cause increased manufacturing costs by demanding an impracticably-high pouring temperature.

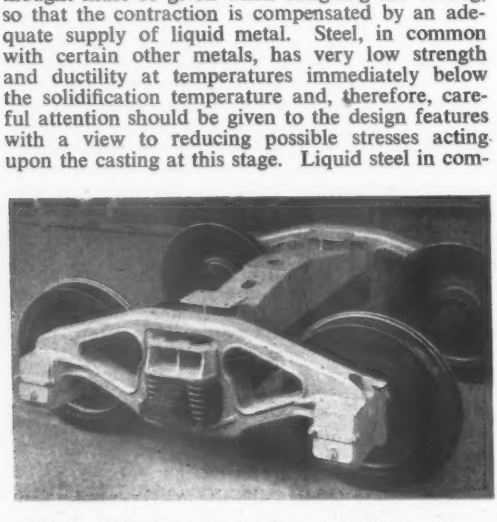


FIG. 6.—*Side Frame and Bolster Assembly to form a Complete Bogie. Note the Clean Lines when this is Produced with Castings.*

Railway Castings

Applications of the foregoing viewpoints on design can be illustrated by examining the production of some railway castings. The railway world of engineering is one which, throughout the world in the last 10 or 15 years, has turned to a greater use of castings. The use of castings for railways calls for materials and standards of workmanship second to none. The castings must be capable of standing up to hard wear, shock loads, continuous strain, and very heavy daily fluctuations in service requirements.

Steel centre fillers such as shown in Fig. 3 are castings used in many thousands in the building of freight cars. A few years ago some of the railways and freight car builders, with their own construction and repair facilities, began to experiment and develop a built-up welded centre filler of steel plate. The welded plate design consists of 17 parts, and requires 672 in. of weld, the whole unit weighing approximately 306 lb. This is illustrated in Fig. 4. In order to meet this competition one foundry began experimenting about two years ago, and developed what is now known as the "three-piece centre filler." This unit is made up of three separate castings, welded and processed in their own shops for eventual delivery to the freight car builders as a one-piece unit. This three-piece casting assembly weighs only 205 lb., giving a reduction of approximately 30 per cent. in weight, a very important factor to railway builders in their endeavour to lighten the weight of rolling stock. This design requires only 34 in. of weld in comparison with 672 in. for the plate weldment, a reduction of 638 weld inches in the assembly of the parts.

The production of this new design was the result of a careful study of the manufacturing possibilities. Preliminary investigations indicated that the three-piece centre filler was more economical and practical from a manufacturing standpoint. Complete development of the method showed a resultant reduction in the weight of core from 308 lb. to a mere 3 lb. per casting, also a considerable reduction in the cubic content of sand necessary for the mould, due to the use of shallower moulding boxes, a reduction in the number of workmen connected with the job and an increase in the daily output of moulds from 110 to 140 per day. In addition, a welding technique was developed which resulted in the operation of welding the three pieces together, all being done in the horizontal position. The net result of the combination of casting redesign and lower manufacturing costs, produced a selling price that was more competitive than the all-welded plate centre filler. As a result, more than 15,000 cast-steel three-piece centre fillers have been supplied in the last two years.

This conscientious interest on the part of the particular foundry in providing a good design

FIG. 7.—*Cast-steel Bogie Frame which Replaced a Welded Assembly. It weighs 2 tons and has an average Metal Thickness of ¾ in.*

resulted in the customer receiving a product superior in service and at a lower cost than the all-fabricated counterpart.

Couplings

The usual method of coupling vehicles together on British railways is by the use of forged hooks and links. It is not, however, the normal method of coupling vehicles together abroad. In the United States, Argentine, South America, South Africa, New Zealand and in many other countries, the standard intercoupling of vehicles is effected by a series of castings ingeniously joined together, as shown in Fig. 5. The earlier designs of these were first put into use in the U.S.A. as far back as the 1870's, but modifications have been progressively introduced to meet the needs of increased loads and faster speeds of transport. However, the designer has always been able to satisfy the conditions of the user, and it is pleasing to note that new standard passenger stock, designed by the British railways, calls for an automatic coupling of a similar nature, incorporating castings.

Separating these automatic couplings into their component parts reveals that this is a job calling for machine moulding and the "blowing" of the necessary cores. In designing such castings, it has to be borne in mind that machining is an expensive business and must be kept to a minimum so that elaborate gauges are used before assembly and minor blemishes removed by grinding. The parts must be interchangeable, each with its type, and a large number of gauges are used in their production. By the use of a design where such methods can be followed in production, the castings are produced economically, and whilst the complete product may be more expensive than the forged hook, it gives a service infinitely superior, with increased speed and safety in transport.

It might be thought that the castings in the coupling illustrated, are unnecessarily elaborate. In determining their shape and section, a high strength-to-weight ratio is called for, and adequate factors of safety and equal distribution of loads are demanded. A chain is only as strong as its weakest link, and, therefore, the shock loads encountered

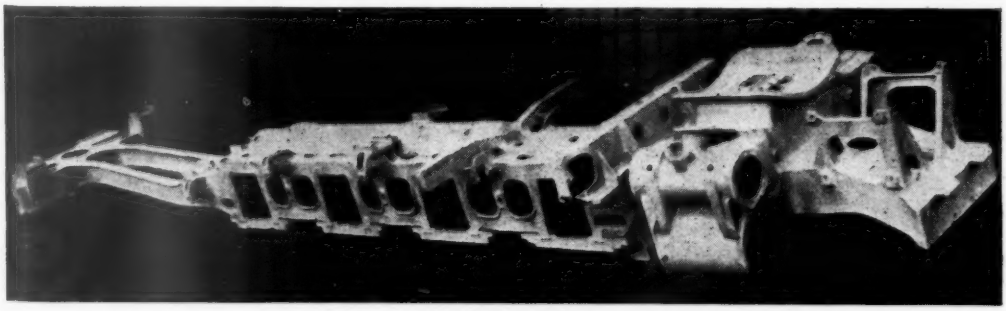


FIG. 8.—*Cast-steel Locomotive Bed Typical of the Trend in America to make such Items (from 40 to 50 ft. long) as Castings. The Single Casting incorporates Cylinders and Cradle Frame.*

Casting Design in Relation to Production

in service have to be spread evenly and over as large an area as possible.

Freight-car Bogie

A fabricated arch-bar frame bogie consists of two side-frames of approximately 30 loose parts, secured by bolts and rivets, and one can imagine that after a certain amount of life, the parts tend to become loose and, as a consequence, maintenance costs are high. Incidentally, such a frame is costly to assemble, and if anything like interchangeability is to be maintained, expensive jigs and fixtures are necessary for making and fitting the various parts.

When the side frame is turned out as a one-piece casting incorporating the axleboxes, the clean lines and the apparent strength are noted. It is easily assembled with the necessary bolster, into a complete bogie, as is shown in Fig. 6. There is a minimum amount of machining carried out on the castings and this usually only consists of the machining of the axlebox faces to form an oil-tight joint with the loose lids, and also around the centre pivot seating of the bolster. In arriving at this design, the first consideration is the selection of material. Cast steel with high strength is the obvious choice, alloy steel would be too expensive, and, therefore, a carbon steel of 28 to 35 tons per sq. in. tensile strength is the basis of the design.

After deciding on a tentative design, the next consideration is the method to be used by the foundry for successful production. To achieve this, evenness of section, avoidance of re-entrant angles, minimum of feeding to produce sound material, are the aims. Consideration of causes for contraction; the use of green-sand or core sand cores; ease of handling of both mould and cores, and the use of the smallest possible moulding box and the minimum of sand are further factors necessary for success. It is obvious for interchangeability and mass production, these castings would be made either on a large jolting machine or, preferably, by sandslinging, and in practice the latter method is the more economical.

Testing

When a particular side-frame design is adopted, elaborate tests of the design are carried out on prototypes before bulk production is commenced. A sample side frame is selected for this purpose, and subjected first to a transverse test, and secondly to a loading test on the base of the side frame, with the casting so positioned in the testing machine as it would be under actual running conditions. Measuring gauges are fitted so that deflection in the middle of the frame can be measured, and readings are taken at certain specified loads and must agree with standards laid down by the Railways Standards Committee. The bolster is also subjected to similar tests. After these two tests are passed satisfactorily, the sample frame is subjected to a destruction test. By comparison with the fabricated bogie, the cast-steel bogie takes one-fifth of the time required to assemble its fabricated

FIG. 9.—*Method of Moulding the Side-members for a Low-slung Railway Wagon which were Cast in Pairs. Moulding Boxes with Collapsible Crib Plates were used to facilitate "Easing" after Casting. For this Purpose the Joint Pins shown in the lower part of the Illustration were withdrawn soon after Pouring. The Pattern Allowance for Contraction on this Job was 6.4 in., and yet the Maximum Length Error ever experienced was only $\frac{3}{8}$ in. These Castings were made during the War for use on Southern Region Railway Wagons used in Transporting Tanks.*

counterpart, and its life, whilst probably not indefinite, is distinctly better than the fabricated job.

Locomotive Bogie Frame

Recent changes in locomotive design, particularly abroad, in conversion from steam to Diesel and Diesel-electric, have increased the use of castings, and allowed for changes in design from fabrication to castings. Fig. 7 shows an electric locomotive bogie-frame which was changed from a fabrication into a more efficient casting. In changing this frame to a casting, the principles previously mentioned, *i.e.*, choice of material, thickness of metal, even sections, contraction of the casting when cooling, etc., had to be considered by the designer, but it was obvious that the method of production would have to be different from that of the side-frame and bolster-bogie castings.

The casting was made in heavy-type moulding boxes on a concrete bed and with a fairly large number of cores. Precautions were taken to ensure that the casting could contract freely. The casting weighs approximately two tons, and its average metal thickness is $\frac{7}{8}$ in. As is to be expected, a certain amount of "setting" of the casting is occasionally necessary, but the technique adopted has resulted in this being kept to a minimum. The finished frame has no machining except of the horn guides for the axleboxes, various pads for mounting the brake-control brackets, and the drilling of holes for pins, etc.

The use of castings to replace fabrication in locomotive manufacture is extending, and one day, in this country, it is hoped that the size of locomotive castings being produced in America and illustrated in Fig. 8 will be attained. The casting incorporates the cylinders and the cradle frame, which is seen at the opposite end. These castings are approximately 40 to 50 ft. long and weigh around the 9 to 12 ton mark. It will be realized that the production of such castings is a very ambitious project. In America, specialized foundries are devoted to their manufacture. The experience gained and the technique being built up on one-piece bogies, hind frames, etc., will, it is felt, allow such castings to be produced in Britain at some time in the future.

Well Wagon

An interesting casting produced in numbers during the war years, was on behalf of the Southern Railway in connection with low-slung wagons for the transporting of tanks. The cast longitudinal members, shown in Fig. 9, were produced as castings in pairs, and special moulding tackle had to be made. The allowance on the pattern for contraction was 6·4 in., and the greatest error in the length of any casting produced was $\frac{7}{8}$ in. The moulding box sides are of particular interest. These incorporate collapsible crib plates. The pulling out of the joint pins allows the mould to collapse freely after casting.

Conclusions

To conclude, four golden rules are fundamental to casting design; they are:—

(1) An attempt should be made to design all sections of a casting as far as possible with a uniform thickness.
(2) It is not desirable to design cast structures with abrupt changes of section.
(3) Sharp corners at adjoining sections should be eliminated.
(4) In designing unfed adjoining sections, all sharp corners at the junctions should be replaced by radii wherever possible, and in "X" sections the arms should be considerably offset.

However, there is probably no single factor relating to production of high-grade castings which is so important as the co-operation between designer, the foundryman, and the user. To start correctly is half the problem of satisfactory production. This means that proper design for good foundry practice is the essential starting point, and can be followed by correct pattern equipment, constructed for correct heading and feeding. In this way some of the many pitfalls to be found in casting production can be alleviated to a large extent.

Car Production Data

A most interesting paper on the production of modern-design cars, presented recently by E. W. Hancock, M.B.E., M.I.MECH.E., M.I.PROD.E., to the Manchester Association of Engineers, contained, amid a wealth of other data, the following percentages by weight of certain groups of materials in a typical modern car weighing 2,600 lb.:—Cast iron, 12 per cent.; carbon and alloy steel, 69; glass, 2.5; zinc, 2.0; aluminium, 0.7; brass and bronze, 0.7; trim materials for body seats and cushions, 8.4; rubber, 4.7 per cent. Another analysis of materials quoted by General Motors and based on a four-door saloon (1951), weighing 3,751.27 lb., is shown in Table I.

TABLE I.—*Metallic Components of a Modern Car.*

	Net Weight, lb.	Per-centage.	Gross weight, lb.	Wastage, Per-centage.
Steel	2,556	68.06	3,320	23
Grey iron	521	13.90	641	19
Malleable iron	99.6	2.70	122.5	19
Total ferrous materials ..	3,176.6	—	4,083.5	—
Aluminium and alloys ..	11.4	0.34	—	—
Copper	26.0	0.69	—	—
Copper alloys	15.6	0.42	—	—
Lead and alloys	30.4	0.81	—	—
Zinc and alloys	66.1	1.76	—	—
Antimony	1.1	0.03	—	—
Manganese	18.8	0.50	—	—
Silicon	17.3	0.45	—	—
Chromium, nickel and molybdenum	7.2	0.19	—	—
Tin	1.37	0.04	—	—
Total non-ferrous materials	195.27	—	—	—

The following details were given of the production of a typical cylinder-block casting. The example is a four-cylinder side-valve casting weighing 114 lb. on receipt from foundry, and weighing 89.35 lb. after complete machining. In the foundry such a casting involves two half-moulds and 37 cores and the metal pattern and core-box equipment alone cost approximately £40,000, and is capable of producing 400 good castings a day in one shift of 8½ hrs. A fully-mechanized foundry can produce 225 tons* of this type of casting in an area of 43,340 sq. ft.

* Presumably per week—EDITOR.

Conditions in the Tuyere Zone

Report of Observations made by High-speed Camera

Research on blast-furnace operation which may serve as a guide to further work on cupolas is contained in an account of a recent investigation reported by J. F. Elliott, R. A. Buchanan, and J. B. Wagstaff in a paper entitled "Physical Conditions in the Combustion and Smelting Zones of a Blast Furnace," presented at a conference held by the American Institute of Mining and Metallurgical Engineers recently. The investigation was initiated in the hope that a better understanding of the combustion region could be obtained by using a high-speed camera operating between 800 and 3,000 frames per second to take a series of colour motion pictures through the tuyeres of a number of blast furnaces.

Passage of Particles

The films show a procession of angular particles dropping down into the air jet of the tuyere. As the jet impinges on them, they are flung violently to the rear of the region viewed, which is rather congested with these particles, all moving away from the camera. The small particles appear to travel at a relatively high speed and the larger particles move considerably more slowly. The time in the air jet ranges from approximately 0.1 sec. for 2½-in. particles down to about 0.01 sec. for ¼-in. particles. So that the rate of burning of coke, which is about 0.043 cub. ft. or 74 cub. in. per sec., is small compared with the quantity of coke moving in front of the tuyere. Identification of most of the particles seen in the films was obtained by photographing a furnace while filled with a coke blank and comparing the field observed with a furnace normally burdened. As there was virtually no difference in the appearance of photographs taken at the tuyeres, it is concluded that the majority of particles at the tuyere zone are pieces of coke.

There is also evident a higher incidence of massive lumps at the tuyere zone in an irregularly working furnace than in one moving smoothly. These sometimes burst under the impact of the jet, discharging bits of coke and ore. One explanation is that during irregular operation there is a greater chance for a small pocket of coke and ore to be walled off by partially solidified slag. Then this lump may be thrust by a slip into the combustion zone before being smelted. Sometimes these larger pieces fail to break up when they enter the raceway; they seem to be too big to be blown round, so they settle to the bottom of the visible region and slowly melt away. Careful examination of pictures of such lumps suggests that they are agglomerates formed within the furnace.

One gets the impression, when viewing the films, that the coke particles are moving backward into a rather large void, and that just within view behind the moving particles is a highly luminous wall. With no depth index, it is impossible to judge the size of this void or the distance to the wall. Close observation shows that there is a general tendency for particles in motion to rise slightly as they are blown rearward, and some of the larger ones even roll upward as though being pushed up an inclined plane. This last effect, coupled with the fact that some of the coke particles dropping in front of the tuyeres are very bright, leads to the postulation that circulation of coke is about a vertical circle with the jet roughly tangential to the lower edge.

The authors proceed to discuss the performance of models, and relate the phenomena observed to work done on packed absorption towers with a liquid passing down countercurrently to vapour moving up. According to their hypothesis, the whole process of particle movement is unstable and, once started, tends to build up. It is, the authors point out, easy to visualize an irregularity occurring, with the result that the blast pressure builds up, the column begins to hang, and unsteady operation, with slips, ensues. In extreme cases, an impermeable layer could form completely across the furnace, interrupting production.

Conclusions

This study of the tuyere zone of the blast furnace, state the authors in their conclusions, has shown, with reasonable certainty, that in a normally functioning furnace there is a rapidly moving raceway of gases and coke before each tuyere. This is contrary to the frequently-held concept that there is a relatively stationary bed of coke and other solids slowly descending in the tuyere zone. The diameter of the raceway ranges from 2½ to 5 ft. in full-scale furnaces. The work reported has not yet progressed to a stage where all factors controlling the size of the raceway can be completely defined, and as yet little is known of the width of these raceways. The work has given a new meaning to the expression "penetration of the blast," as it is reasonable to conclude that the most important effect of changing the penetration is not chemical but physical, the effect of changing the raceway diameter. This, it is considered, has an appreciable effect on the flow of gas farther up the stack, but how much is unknown.

There is some evidence to suggest that the size of the raceway in an irregularly operating furnace is somewhat variable and erratic. Suppose that for some reason the coke is prevented from entering the raceway for a short time; as, for example, would occur if the coke arched across above the raceway. Then the raceway is bound to increase in size because the coke is continuously consumed. This, it is suggested, may be a contributing factor in the erratic results found in a plant referred to by the authors.

Zinc Bulletin, No. 10. Issued by the Zinc Development Association, Lincoln House, Turl Street, Oxford.

With the recent removal of all restrictions, together with the fall in price, interest is being reawakened in the engineering possibilities of zinc alloys as die-castings. This issue carries an illustrated article showing the use of these components in Austin motor cars. Another important use of zinc is for hot-dip galvanized castings, and the mills at Margam have been used by way of illustration. Zinc glazes for pottery is a further subject included. A survey of the zinc market completes the contents.

Institute Elects New Members

At a meeting of the Council of the Institute of British Foundrymen, held at the Waldorf Hotel, Aldwych, London, W.C.2, on January 17, the following were elected to the various grades of membership.

FIRST LIST

As Subscribing Firm Members

Checketts & Company, Watsons Green Works, Cromwell Street, Dudley, Worcs, wood and metal patternmakers. (Representative: R. A. Checketts.)

Stockton Casting Company, Limited, Ross Road, Portrack Lane, Stockton-on-Tees, Co. Durham, iron and bronze founders. (Representative: Tom Wolverson.)

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M. H. Al-Bank, student, National Foundry College, Wolverhampton; J. D. Ashman, technical representative, Morgan Crucible Company, Limited; J. H. Baines, A.M.I.MECH.E., technical assistant, Ministry of Supply, Chorley, Lancs; E. R. Balmforth-Willetts, technical foundry representative, British Industrial Plastics, Limited, Oldbury, Birmingham; H. Barton, foundry foreman, Mavor & Coulson, Limited, Bridgeton, Glasgow; Wm. Blogg, coremaker, Richardson, Westgarth & Company, Limited, Hartlepool; W. H. L. Brazier, superintendent, foundry resins development, British Industrial Plastics, Limited; I. E. Brown (Mrs.), metallurgical laboratory assistant, Douglas (Kingswood), Limited, Bristol; A. D. Campbell, metallurgical chemist, West Lothian Steel Foundry, Armadale; J. T. Campbell, foreman, Mavor & Coulson, Limited, Bridgeton, Glasgow; D. H. Carter, technical representative, Morgan Crucible Company, Limited; T. W. Clifford, general moulder, R. Taylor & Sons, Larbert; A. E. Cowan, inspector, Mavor & Coulson, Limited; F. Davies, iron moulder, North Foundry Company, Monton, Eccles; R. T. Cutler, wood and metal patternmaker, G. Perry & Sons, Leicester; J. T. Fellows, iron moulder, British Railways, Crewe; F. Gilliver, metal flux manufacturer, Foundryflux, Limited, Birmingham; F. C. Goldsmith, technical representative, Foundry Services, Limited, Birmingham; J. Harrison, assistant foreman, iron foundry, British Railways, Crewe; G. A. Haynes, production engineering assistant, African Malleable Foundries, Limited, Benoni, South Africa; R. H. Hoby, chief of tool-design office, Trico-Folberth, Limited, Brentford; G. A. Hopkins, director, Sidney Foundry, Limited, London, N.19; L. A. V. Huxter, foreman moulder, Cronite Foundry Company, Limited, Frome, Somerset; A. A. Leeland, technical representative, Fordath Engineering Company, Limited; G. H. Longden, patternmaker, Morris Motors, Limited, Wellingborough; J. Ludford, melting foreman, British Piston Ring Company, Limited, Coventry; H. G. Lyddall, foundry foreman, Chiswick Foundries, Limited, Gunnersbury, London; L. G. Margree, London manager (foundry division), Thos. W. Ward, Limited, Sheffield; D. Miller, foreman, Mavor & Coulson, Limited; C. McCormick, moulder, "Inclidon," Benoni, Transvaal, South Africa; G. Ohira, assistant professor of Tohoku University, Japan; C. J. Portway, assistant foundry manager, Tortoise Foundry Company, Limited, Halstead, Essex; R. Richardson, chief metallurgist, Shanks & Company, Limited, Barrhead, Glasgow; A. L. Ritchie, foreman coremaker, Mavor & Coulson, Limited; J. S. Roy, steel foundry foreman, Clyde Alloy Steel Company, Limited, Motherwell; M. Sabbatini, foundry engineer, International Meehanite Metal Company, Limited, London, S.W.1; M. Shafi, section officer trainee, Pakistan Government Ordnance Factory; R. Talbot, foundry chemist, Mavor & Coulson, Limited; P. Venketeswaran, senior supervisor, National Machinery Manufacturers, Limited, Bombay, India; J. Wardle, foundry manager, Yewtree Ironworks Company, Limited, Hollinwood; W. T. Watt, foundry superintendent, Dewrance & Company, Limited, Hillington, Glasgow; S. T. Willy, foundry foreman, Elliott Bros., Lewisham, London; L. Arzewski,* assistant chemist, Dartmouth Auto Castings, Limited, Smethwick; P. G. Chapman,* technical assistant, investment foundry, De Havilland Engine Company, Limited, Middlesex; P. R. Gunn,* assistant foundry manager, Langley Alloys, Limited, Slough, Bucks; J. Massey,* iron and steel founder, Heaton Foundry Company, Newcastle-upon-Tyne; W. J. Pollock,* ironfoundry metallurgist, Mather & Platt, Limited, Manchester, 10; S. D. Smith,* patternmaker, Masson Scott & Company, Limited, London, S.W.17; A. Sutherland,* G.I.MECH.E., foundry plant engineer, Ruston & Hornsby, Limited, Lincoln.

As Associates (over 21)

J. F. Burns, moulder, Clarke, Chapman & Company, Limited, Gateshead; J. H. Burtonwood, journeyman loose-pattern moulder, Wm. Wadsworth & Sons, Limited, Bolton; R. W. Coxon, moulder, Clarke, Chapman & Company, Limited; R. F. Davies, chief metallurgist and foundry manager, Wednesbury Tube Company, Limited, Bilston, Staffs; D. Douglass, moulder and coremaker, Clarke, Chapman & Company, Limited; P. C. Gutteridge, foundry facings manufacturer, Isaac & Israel Walker, Limited, Rotherham; M. G. Hazelwood, patternmaker, M. G. Hazelwood, Victoria, Australia; D. R. Keith, apprentice patternmaker, Babcock & Wilcox, Limited; S. Lee, floor moulder, Clarke, Chapman & Company, Limited; A. D. Lewis, foundry foreman, Henry Wallwork & Company, Limited, Manchester, 4; M. Lowes, floor moulder, Clarke, Chapman & Company, Limited; Wm. Montague, moulder, Clarke, Chapman & Company, Limited; D. P. Mooney, moulder, Mitcham Foundry,

* Transferred.

Institute Elects New Members

Surrey; C. McLean, foundry chemist, Mavor & Coulson, Limited; E. Nelson, student, National Foundry College; J. Nicholson, moulder, Clarke, Chapman & Company, Limited, Gateshead; R. J. Patley, supervisor of phosphor-bronze foundry, Dowson & Dobson, Limited, Transvaal, South Africa; J. Quinn, moulder, Clarke, Chapman & Company, Limited; T. Ramchandran, student, National Foundry College; A. Riley, supervisor, Sterling Metals, Limited, Coventry; E. Roberts, foundry estimator, Langley Alloys, Limited; K. Rosen, student, National Foundry College; K. R. Twemlow, student, National Foundry College; J. Walker, coremaker, Appleby & Company, Sheffield; T. A. Walker, coremaker, Appleby & Company; T. D. J. Weaver, student, National Foundry College; R. W. Hall, assistant metallurgist, International Harvester Company, Limited, Doncaster.

As Associates (*under* 21)

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SECOND LIST

As Subscribing Firm Members

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As Associates (*over* 21)

J. Algar, foreman patternmaker, Crown Foundry Company, Limited, Northampton; R. Baker, iron moulder, Crown Foundry Company, Limited; J. Bell, special foundry apprentice, Stanton Ironworks Company, Limited; C. Buckley, technical representative, Coleman-Wallwork Company, Limited, Beds; K. T. Cator, chargehand, S. Russell & Sons, Limited, Leicester; G. Chamberlain, chargehand, Rice & Company, (Northampton), Limited; H. F. A. Goodger, foundry foreman, Northampton Foundry Company, Limited; W. R. Herbert, foreman patternmaker, Northampton Foundry Company, Limited; C. D. Lowe, assistant metallurgist, Rolls Royce, Limited, Derby; W. H. Mackness, foundry foreman, J. Williamson & Company, Limited, Northants; A. Marriott, coreshop chargehand, Rice & Company (Northampton), Limited; C. A. Minards, foundry foreman, Crown Foundry Company, Limited, Northampton; A. Noland, planning and progress officer, Rice & Company (Northampton), Limited; J. R. Orr, progress engineer, Crown Foundry Company, Limited; R. J. Robinson, inspector of castings, Rice & Company (Northampton), Limited; G. Smout, foundry planning engineer, International Harvester Company, Limited, Doncaster; H. Spring, general foreman, Rice & Company (Northampton), Limited; W. J. Walton, draughtsman-estimator, Rice & Company (Northampton), Limited; J. W. Wright, jobbing moulder, Rice & Company (Northampton), Limited.

As Associates (*under* 21)

E. S. Brown, apprentice foundry engineering draughtsman, John Gardom & Company, Ripley; M. A. Clarke, apprentice moulder, Rice & Company (Northampton), Limited; R. W. J. Park, moulder and patternmaker, Crown Foundry Company, Limited.

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R. K. Banerjee, instructor (moulding section), Industrial Training Institute, Bengal, India; E. A. Dyson, patternmaking instructor, Loughborough College of Technology, Leics; H. C. Foster, foundry metallurgist,

(*continued on page* 191)

* Transferred.

Dressings for Dies

By W. M. Halliday

A prevalent irregularity occurring with pressure die-casting, in many of the common alloys, is that of the adherence of layers of molten alloy in the form of a built-up deposit on certain areas of the die cavity wall. This article first deals with the nature of such deposits, their effect on die-casting practice and difficulties attending their removal and concludes by detailing suitable preventive measures which can be applied to the dies initially.

The tendencies towards metal build-up on the dies when die-casting are greater with certain alloy groups, and it generally occurs in its most troublesome form with the high-melting-point alloys. Tin and lead-base alloys, having negligible affinity for ferrous metals, and being worked at comparatively low temperatures and with only slightly-heated dies, occasion no appreciable trouble in respect of such deposition. On the other hand, zinc-, aluminium-, copper- and bronze-base alloys, which have some affinity for die steels or cast-iron machine parts, and which have to be worked at high temperatures, great injecting pressures, and with very hot dies, possess the greatest proclivity towards this kind of fault.

The actual building-up process of such molten alloy appears to be closely analogous to that of ordinary galvanizing. A succession of film-like alloy layers are deposited by the repeated injection of shots into the cavity; when solidified these become strongly welded together to form a hard raised patch which adheres tenaciously to the affected cavity wall.

Such alloy deposit is most frequently concentrated upon certain portions of the die matrix, normally upon the wall immediately opposite to the gate opening if the flow between those two points is uninterrupted by intervening cores or projections; or upon the areas of cavity walls nearest the gate opening. During the filling of the cavity, the main portions of the flowing charge strike such surface areas with far greater pressure and rapidity than the other portions fed by a diverted flow. The tendency towards such build-up is increased if these particular surface areas are rough or damaged, *i.e.*, by the presence of tooling marks, poor polish, nicks, or bruises, etc.

Contributory Factors

Oxide or scale inclusions carried through to the cavity with the molten alloy stream may also accelerate the tendencies to such build-up. Oxide masses and the like are powerfully impacted against the rough-surface patches of the cavity, there they are segregated from the alloy stream, and remain as further rough excrescences at the particular spots when the solidified casting is ejected. At the next injection shot into the cavity, boundary layers of the molten charge will again strike such oxide-coated rough surfaces and adhere thereon more readily to form a build-up of the objectionable deposit. The high-injection pressures, and great velocities employed with modern die-casting techniques to obtain faster casting speeds, and maximum homogeneity in finished die-cast parts, also increase the tendencies towards this kind of trouble.

Considerable difficulties are experienced in removing built-up alloy accretions of this character. Usually this can only be achieved by adoption of some kind of machining, or powerful abrasive polishing operation. It is nearly always difficult and hazardous to pry off such deposited alloy by means of bars or chisels, because serious damage may be inflicted on the cavity surfaces.

The undesirable effects produced on finished die-cast articles by such cavity accretions may be numerous and serious. For instance, the raised rough deposited patch on cavity wall is reproduced in negative fashion on the sides of the die-casting in the form of a sunken area coinciding in shape and depth with the deposited patch. Removal of such a fault necessitates much additional polishing or machining of the casting according to the magnitude of the depressed area. Ejection of castings is also retarded due to the tendency of parts to "hang" or stick to rough built-up excrescences in the cavity. In extremely aggravated conditions, the side of a solidifying casting may become slightly welded to the alloy deposit on the cavity wall. Should this occur, ejection of the casting may result in portions of the wall-section being torn away. The accuracy of finished die-castings may thus be adversely affected, especially where the built-up accretion lies across some plane of critical tolerance. Alternatively, dimensional errors may arise due to distortions and bending of the casting during its forcible ejection. Numerous production delays are encountered on account of the repeated need to remove such alloy deposits, for in many instances the machine has to be shut down and the die removed and set up for machining out the bad patch.

Remedies

Much can be accomplished to obviate or reduce the onset of such an irregularity, by the choice of suitable die steel, and more careful die design and construction. Nickel-alloy die steels are available, having exceedingly close-grain structure, cleanliness and great resistance to heat and chemical attack such as arises with contact with molten alloys. Some of these alloy-steels are expensive and difficult to machine, however, which factors often limit the choice. Greater freedom from the trouble may be gained by ensuring the best possible finish on all cavity walls, and specially guarding them against mechanical damage during use, or the development of hair-line cracks due to thermal fatigue of the die steel.

Dressings for Dies

The design of the die may usefully be modified in various ways to minimize the tendencies to such accretions. Attention to the following factors is of importance in this connection:—The location of the gate entry into the cavity relative to main direction of flow, cores location, etc.; flow directions of the incoming alloy charge, and the temperature of die and alloy; the means employed on the die to ensure a uniform thermal balance and evenly distributed heat-radiation from the tool. Avoidance of grossly-unequal wall-sections on both the die-cast component and die walls is desirable.

Die Protection

Despite resort to all these measures and the undoubted help they can give, alloy deposition troubles may still persist, even with zinc-base alloys which are worked at only medium temperatures. Where the conditions cannot be corrected by design adaptations or the use of superior heat-resistant alloy-steels, etc., the most satisfactory and economical solution is to be found in the use of protective dressings for the vital surfaces of the die matrix in contact with the molten alloy. Such dressing treatments prove very efficacious for zinc-base and the still-higher-melting-point alloys.

Numerous preparations are available for such service dressings, some of a proprietary character, others capable of being easily compounded in the foundry as and when desired. Some of these latter, however, despite their ability to prevent alloy deposit formation, have undesirable effects in other directions. For example, they may speedily burn, char, or flake after very short exposure to the molten alloy charge, or in contact with the heated die. They may give off masses of gas or vapour which may easily become occluded in the alloy charge, later to be trapped at some point in the die cavity. The preparations may have poor adherence to steel, or be pervious to heat and chemical action, thus leading to early breakdown, or the need for frequent application.

To be effective, any die-dressing should have high resistance to heat and chemical actions and sufficiently durable to give proper protection to the cavity walls for a sufficient length of time to ensure economical, smooth, and continuous operation. They should be applicable to the cavity in an even fashion, and preferably incur no blackening or other marking of the finished casting. In addition, they should be inexpensive, easily applied, and capable of being stored with safety.

Powder-type Dressings

Generally, die-dressings are of two kinds, powders or pastes, and usually the latter kind are found to be the most economical and satisfactory. Die dressings impermeable to heat, comprising flocculated talc, tripoli powder, finely-ground chalk or whiting, powdered sodium peroxide, graphite flour and similar materials are frequently employed, and mixtures composed of several of these materials are sometimes used with excellent results in the prevention of alloy deposits.

Whilst powder dressings of this character give good protection, they have to be applied very frequently (*i.e.*, after every 20 or 30 shots into the die) owing to the poor adherence properties of the loose powder particles. Moreover, powder dressings cannot easily be applied to restricted surface areas of the die cavity, generally all surfaces have to be dusted, and excess powder may settle on other parts of the die mechanism not requiring such treatment. On the other hand, powder preparations can be applied, by brush or spray gun whilst the die is mounted in place on the machine platens, thus much time may be saved. Further drawback with powders is the difficulty experienced in obtaining an evenly-distributed coating. They also have a tendency to coagulate in patches or large-size flakes leaving bare patches of die metal.

Paste-type Dressings

An application of a coating of iodine to the surfaces of the die cavity will be found effective in protecting against the chemical and heat action of zinc-base alloys. Alternatively, a paste may be made from a mixture of sodium-peroxide with iodine. When evenly applied, this will not only prevent alloy deposits forming on cavity walls, but will assist in minimizing the effects of thermal fatigue-cracking on critical die surfaces over which the molten alloy flows. The particles of this paste preparation enter into fine cracks, and to a considerable extent seal them against ingress of molten alloy. Such a paste should be very thinly applied when the die is warm, and allowed to dry normally, after which the treated surfaces are lightly rubbed to obtain a smooth surface of high polish.

Another useful inexpensive dressing mixture applicable for use with zinc-base alloys may be made from a thin paste of ordinary lampblack suspended in a volatile spirit. This may be applied whilst the die is cold, and the coated surface should be rubbed smooth as with the previous method. Finely-ground or de-flocculated graphite powder mixed with clean water, into which a small amount of gallotannic acid has been added, will produce another extremely effective dressing, suitable for several alloys.

The coating obtained from these last two dressing mixtures is durable, impervious to heat and chemical action, and possesses good insulation properties. On the other hand, their use involves some blackening of surfaces on the die-cast article which may prove objectionable on account of the additional buffing or polishing required for its removal.

Special Dressings

Dies used with the high-melting-point alloys, such as aluminium-bronze and other copper-base alloys, are liable to extensive and often severe heat and chemical attack from the incoming molten charge. To meet these particularly stringent protection needs, a mixture consisting of powdered chalk or tripoli suspended in a light mineral oil

to form a stiff paste is found very advantageous. Frequent and regular applications should be made, the coating being evenly applied and lightly polished in normal fashion after drying. Dressings of this kind are considerably improved in respect of adherence to the steel and durability if the die surfaces are first de-greased and then lightly coated with a sodium-silicate solution. This preliminary affords better bonding between steel and the final dressing.

Another valuable die dressing for use particularly with nickel-alloy cast-iron dies as used for gravity die-casting of brass, aluminium-bronze and other copper-base alloys is composed of a dilute solution of sodium-silicate alone. This may be brushed or sprayed onto cavity surfaces, whereon it quickly forms into a hard, tough, film-like coverage. To some extent this mixture will flow into the "pores" of the cast-iron to seal them against entry of alloy particles. Such a coating not only prevents alloy accretions on cavity walls, but improves the ejection of castings by reducing their tendency to stick.

In the case of cast-iron dies used with aluminium alloys, the following dressing gives very beneficial results:—A quantity of finely ground whiting is mixed into a stiff paste with water into which has previously been added a small amount of water-glass in the proportion of about 2 ozs. per gall. The die surfaces are thoroughly coated with this mixture, dried and then given a dressing with a graphite paste.

This form of dressing will also be found helpful for treating other machine parts, such as nozzles, melting-pots, goosenecks etc., which are to be immersed in the molten aluminium alloy. The purpose of the secondary graphite paste dressing is to ensure a completely unbroken film over parts before immersion in the metal. Die-dressings composed of animal or vegetable waxes, or bonded with heavy mineral oils are to be avoided, on account of their deleterious tendency to burn and develop gases, or leave scale deposits in the die cavity.

Conclusions

The chief objective sought by use of die-dressings of the kind described is to prevent the formation of alloy deposits on the wall of the die cavity, but it is worth while noting this is not the only useful function they may serve. Dressings also act as insulation against undue heat losses from thin sections of the die by radiation. Most of the preparations described have good insulating properties when properly applied. Furthermore, the die-dressing may also retard considerably chemical attack on die steels by the alloy charge, so preventing pitting, staining and scaling effects, which would otherwise be transferred to the surfaces of the die casting in the form of blemishes.

Die-dressings facilitate the ejection of castings, by reducing their liability to stick on cavity walls. To some extent such dressings act as lubrication for the casting to ease it out of the die cavity during ejection. Such lubrication is of a dry character thus precluding formation of gases and vapours normally arising with wax or oil-base dressings.

Dressings evenly coated over cavity surfaces will usually afford some improvement to the surface finish of the castings produced and the working life of the steel or cast-iron die will similarly be enhanced by the judicious use of the table dressing. Smoother and faster operation of the die is ensured, due to elimination of stoppages in production otherwise necessary for die cleaning. Accuracy of dimension and shape may also be much more easily controlled from a properly treated die, since build-up of alloy accretions and variations in die sizes alike are avoided by the better thermal balance obtained in the tool.

As a general rule, it is advisable to have the die removed from the machine for coating purposes and the surfaces to be treated should be well cleaned, and de-greased in advance. Best results and simpler application will be obtained if all surfaces of the cavity are brushed or sprayed. Spraying is the best medium to be adopted for providing an even thickness of coating, and it is better to give the die two or three very thin dressings successively, rather than a single thick coating. Care has to be observed so that dressing is not applied when the die is exceedingly hot, or immediately on removal from the die-casting machine. A too-hot die causes the protective dressing to wrinkle, and impairs its adherence. With any of the dressing mixtures quoted, it is unnecessary to have the die hotter than about 80 to 100 deg. C. After application, the die should be allowed to cool normally before polishing the surface of the dressing.

Careful attention should be devoted to the protected die during production of the castings, periodical inspections being made to control durability and evenness of coating. If any break is noted in the latter, a further thin coating of dressing should be applied immediately. The chief object is to apply dressings in sparing quantity at each treatment, but to make regular applications. Dressing materials should be carefully stored in sealed containers to avoid contamination. Even minute particles of dirt, metal, etc., entering into such mixtures may produce undesirable abrasive action, or prevent the proper bonding of the dressing to the die.

Institute Elects New Members

(*Continued from page* 188)

Clarke Chapman & Company, Limited; R. N. Hannigan, foundry manager, Humber Graving Dock & Engineering Company, Limited, Lincs; J. T. McMullan, non-ferrous foundry foreman, Fairbairn Lawson & Combe Barbour, Limited, Northern Ireland; A. H. Robson,* metallurgist, C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, 6.

As Associates (*over* 21)

A. Anderson, foundry patternmaker, C. A. Parsons & Company, Limited; E. Brown, patternmaker, C. A. Parsons & Company, Limited; J. Lambie, metallurgist, Wilson Pipe Fittings, Limited, Glasgow; N. Patrick, patternmaker, C. A. Parsons & Company, Limited; G. Robson, patternmaker, C. A. Parsons & Company, Limited.

As Associate (*under* 21)

P. F. Gledhill, apprentice patternmaker, James Maude & Company, Limited, Mansfield, Notts.

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* Transferred.

Income-tax Assessment and Procedure

By F. J. Tebbutt

Many alterations effected both by legislative and administrative provisions have been made in recent times concerning income-tax assessment procedure, and it was thought that details of the most important changes up to date, inclusive of those in the Finance Act, 1952, would be of interest to readers. Mostly this article applies to schedule D (business profits; persons on own account), but reference in some cases is necessarily made to schedule E (employments; pay as you earn). Assessments being received (Finance Act, 1952, matters included) will apply to income in the year ending April 5, 1952, or earlier date, according to the financial year ending date of the firm in question (*e.g.*, December 31, 1951). For schedule E the tax applies against current earnings.

Machinery and Plant: Depreciation Allowances

The amounts for depreciation generally which may appear in balance sheets do not apply for income-tax purposes, but there are allowances for "wear and tear" for machinery or plant (this is a wide term, including not only machinery or plant in its usual sense but motor vehicles and fittings and fixtures). These "wear and tear" allowances operate by the deduction of percentage allowances each year, according to the particular type of machinery or plant, and usually they apply by "agreed rates" between the revenue people and trade associations. Nevertheless, these allowances by "agreed rates" are subject, for any trade, to an addition of one quarter to the particular rate (as example motor vehicles 20 per cent., plus one quarter, totals 25 per cent.). There is a balancing allowance which applies where fresh machinery, etc., is installed before the capital expenditure on the old has been absorbed by the other allowances, roughly running to the amount not taken at that period.

Under the Income Tax Act, 1945, there were "initial allowances" introduced, where fresh machinery or plant (whether new or secondhand) was installed, these being 40 per cent. for expenditure incurred after April 5, 1949, but by the Finance Act, 1951, such initial allowances in connection with any expenditure incurred on or after April 6, 1952, was not to apply for tax-deduction purposes, the provision being suspended until such date as Parliament may determine. There were also "initial allowances" on new industrial buildings (10 per cent. under the 1945 Act), but these allowances are also suspended similarly. In connection with industrial buildings there is an annual allowance of 2 per cent. which applies to both new buildings and under 50 years old buildings each year up to a life of 50 years—this still applies.

Special Points, Contrasts and Differences

Until the 1952 Finance Act, profit tax payments were deductible for income tax, but now this is not so, that is, not for the year 1951-52 or any subsequent year of assessment. The interest received on treasury tax certificates taken out in advance of tax payments is not liable to tax; but interest may be charged where tax payments are outstanding three months after due date for payment. Particulars of interest paid or credited to persons by a banker or similar person may be required to be given to the revenue authorities by bankers, etc., including names of the recipients and the amount of the interest in any specified year. Such a date cannot be a year ending more than three years before the date of the notice asking for the information. Furthermore, these particulars of interest need not be included if the amount does not exceed £15; this provision, however, applies to the post office savings bank accounts. Any fees paid or expenses incurred in obtaining for the purposes of a trade, the grant of a patent (or extensions), the registration of a design or trade mark (or extensions or renewals), can be deducted as an expense for tax purposes, and, by the Finance Act, expenses incurred where application for a patent has been rejected or abandoned are now similarly allowed. Furthermore, even though regarded as capital outlay, expenditure on purchasing patent rights is deductible, although not all at once, being by yearly instalments spread over a period (ordinarily 17 yrs.). The vendor is assessed, however, on the amount received, and this can be spread over a period of six years if the vendor so prefers; the vendor's income under this provision goes through as earned income and so attracts "earned income" allowance.

One provision concerning "losses" has been altered. The position has been that a trader can set off any loss against future profits, but only within a limit of six years. Now, by the Finance Act, 1952, "losses" can be carried forward against future profits indefinitely, that is, the limitation to six years is ended. It might be added that a loss in one business can be set against profits in another business (*i.e.*, distinct trades) in the same ownership.

Research and Other Special Expenses

In connection with scientific research, certain items such as salaries or fees of the staff, cost of materials, repairs and maintenance are allowable as trading expenses. Moreover, capital expenditure on such things as pilot plants and laboratories is allowable, but the amount is spread over a period of five years (originally one-fifth deduction a year) but for expenditure incurred after April 5, 1949, the deduction is 60 per cent. for the first year with 10 per cent. for each of the remaining four years of the five. Wages, salaries, expenses, etc., paid to employees are, of course, trading expenses and allowable in connection with employers' assessments (schedule D). But for directors (and employees with emoluments of £2,000 p.a. and upwards), if the remuneration is plus a lump sum for expenses, this must be included with the remuneration amount in the return of income for the recipient's assessment under schedule E. Ordinary expenses incurred in doing the job are, however, allowable before tax is paid, if claimed (schedule E).

Unemployment, sickness, and maternity benefit received is not now taxable. On the other hand, the part of the National Insurance contribution attributed to those benefits is not now deductible from tax, but the amount which the employer pays in connection with employee's contribution, of course, is deductible as a trading expense. Contributions to charities are not ordinarily allowable, but they are where these are for the welfare of the employees. Similarly, contributions to trade charities and to employers' organizations, if associated with the particular trade, are allowable. Furthermore, contributions, even of a capital nature, made to colleges, universities, or the like, in respect of technical education for the particular trade, are allowable.

Green-strength—what is it?*

It has always been something of a mystery to foundrymen why some natural-bonded sands are stronger than other apparently similar sands. Various theories have been put forward, but undoubtedly the chief reason lies in the type of clay and its plasticity. Several factors go towards this difference in plasticity such as ageing, water and humus content and other physical factors.

Plasticity has been described as "that property which enables a material to be deformed continuously and permanently without rupture during the application of a force which exceeds the yield value of the material." Plasticity is the most important property possessed by clays and it is this which enables naturally-bonded moulding sands to be moulded into shape when wetted with water. This is the so-called green-strength and the foundryman has various ways of improving this property.

Clays apparently possess both "greasiness" and "stickiness" and English ball-clays are noted for the first property and American ball-clays for the second. The causes of plasticity have been the subject of considerable research and several separate though connected theories have been developed.

Envelope Theory

The envelope theory holds that each clay particle is a hydrous silicate of alumina of colloidal size and is enveloped by a film of water. If the water film is thick enough then the particles in the mass flow without the use of much force. As the thickness of the water film decreases, then the amount of force required to make the particles deform or flow increases. The point can be reached where the water content is so low that moulding is impossible, a condition with which most foundrymen are familiar.

Colloid Theory

The colloid theory holds that plasticity is due to the state of extreme fineness or sub-division of the clay particles, which enables them to pass over one another with the minimum of frictional resistance and also causes the mass to display a bond which is proportional to its fineness. In other words, its extreme fineness enables a comparatively small quantity of bonding material to cover a large surface area.

Bentonite is claimed to be a first-class example for this theory. Particles must be approximately spherical to enable them to move easily over each other and so this theory also assumes that the clay particles are more or less spherical in shape. The action of acids and alkalis on clays also tends to support the colloid theory. One method of improving the plasticity of clays is to age them with the addition of small quantities of tannic acid.

Other Suppositions

The combined water theory assumes that clays are made up of hydrated particles. The water of crystallization can all be driven off at approximately 450 deg C. and at that temperature the clay looses all its plasticity. There are various objections to this theory with which there is not the space to deal.

The organic theory assumes that plasticity can be attributed to the decay of organic matter present in the clay. Humic acid is formed and this contributes to the flocculation of the colloidal-clay particles. Associated with this theory is the bacteriological one which

(*Continued at foot of col.* 2.)

*Extracted from *Bradley's Magazine.*

assumes that fermentation takes place with the liberation of hydrogen sulphide. This, as in the case of humic acid, increases the plasticity of the clay. It is a fact that humus and bacteria are always found in clay.

Finally, the alkali theory assumes that plasticity is due to absorbed alkalis. Ball clays and bentonite contain a high percentage of absorbed sodium and potassium salts and it is known that the addition of an alkali can improve the plasticity of clays, although this is not always the case.

The foundryman is chiefly interested in the results he obtains when moulding a sand but what has been said may stimulate interest in the theoretical concept of the strength of naturally-bonded sands.

Publications Received

Directory of Members.—Issued by the Aluminium Development Association, 33, Grosvenor Street, London, W.1.

This useful 18-page directory should be extremely useful to all buyers of aluminium components, for herein are listed the main producers in this country. A clear statement of the objects of the Association is printed.

Smokeless Air. No. 84. Published by the National Smoke Abatement Society, Chandos House, Buckingham Gate, London, S.W.1. Price 1s.

This issue is of particular interest to founders manufacturing in modern open grates. Editorially, there is unqualified disapproval of the supply to the house holder of "nutty-slack" as this, it is stated, is "one of the most effective and unfailing ways imaginable of producing smoke—thick, tarry, low-temperature smoke with its full quota of benzpyrene." It is announced that a sub-committee has been set up to report on the use of nutty-slack. This 30-page bulletin certainly makes interesting reading.

Temporary Prevention of Corrosion of Metal Surfaces. Issued as B.S. 1133—Packaging Code by the British Standards Institution, 24, Victoria Street, London, S.W.1. Price 10s. 6d. net.

It is essential to define the word "temporary" in this context. It means any surface preparation applied so as to minimize corrosion between manufacture and ultimate use. Hence it is part and parcel of the general problem of packaging. How difficult this is can be instanced in the case of a change of the nature of paper used for packaging fine steel components setting up corrosion. It should not be thought, because of the activities of the publishers, that this 100-page booklet is mainly devoted to the postulation of minimum tolerances as a basis of acceptance. It is a useful little textbook covering surface preparation by mechanical and chemical means. It differentiates between the results given by sand- and shot-blasting, but there is a bar against the former method and permission to use it is restricted to very special cases. The notes on pickling and similar processes are elementary, but none the less interesting, as but few are experts in all fields of corrosion prevention. It is a very suitable booklet to have available for reference, as its main good feature is its comprehensive character.

THE TREASURY has made the Import Duties (Drawback) (No. 1) Order, 1953, which provides for the allowance of drawback of Customs duty paid on certain imported components and assemblies for water-heating appliances.

Early 19th Century Commerce

By T. R. Harris

Old business letters, written with no thought of the future, often throw interesting light on commercial conditions of a bygone day. Recently the writer was fortunate enough to find such a bundle of letters, some of which were written to an engineer, founder, and merchant of the West Country by his agent in South Wales, and others from a Welsh ironmaster.

One of the letters, written from Swansea by the agent on August 28, 1831, tells of a visit he made to "Mr. Crane at his colliery." Commenting on Mr. Crane, the agent writes:—"His own consumption of coal is very great; a large portion of the small at the Rose Vein is burned to coke for his ironworks and the larger of the Great Wood coal he burns openly for coke. He has an iron mine within a mile of his foundry and the Swansea Canal runs direct from his foundry to the coal pits; he employs upwards of 500 people and is like a little king at Yniscidwyn. He sends much castings to Mr. Nevill, Llanelly, and supplies a part of Wheal Towan. He is anxious to send castings to Cornwall. He quoted his prices to you, I believe; Mr. Brunton is his engineer. . . ."

The mention of a quotation of prices is confirmed by a letter dated July 5, 1831, from Yniscidwyn Iron Works, near Swansea.

About a special coal known as "The Quaker Coal," writes Crane, "If you have been in the habit of buying this coal, we shall (in about a month) have much pleasure in offering it to you. This coal we have for some years used in our air furnaces for smelting iron (for which purpose it is admirably adapted) and likewise in a state of coke for our blast furnace. . . . This works has been long known for its great advantage in point of ironstone over, we believe, every other in the Principality. We are working that mineral perhaps at two-thirds of its average general cost and, with respect to fuel, we are (from the extensive collieries which we have lately successfully opened) not placed in an inferior one to most others in the trade. Under these circumstances it is in our power to execute castings upon very low terms. Are there not many articles in this way that you might purchase from us on more favourable terms than you manufacture them at? For instance, tramplates on the terms last quoted. Pumps of an excellent quality (of course, in dry sand) at £5 12s. 6d. above 10 inches. Stamps heads with shanks at £4 7s. 6d., without shanks £3 17s. 6d. These are articles of which it would be possible to keep a small assortment without undue risk."

Iron of "Extraordinary Strength"

Some four years later Crane was again writing regarding prices. "Working barrels we should now charge delivered at Swansea, bill at three months (in conformity with the general resolution of the iron trade) in London, £17. Flanch pipes, equal to any turned out in the Kingdom, all proved, 4 to 8 inch £8, 9 to 12 inch £7 10s., 13 to 18 inch £7 5s. These are prices which are quoted to you only as a founder; to private parties we should name very different ones. Our iron is well known in the trade for its extraordinary strength. We get high prices in Staffordshire, and this accounts for a large portion of our make. Our present prices of pigs are as follow:—No. 1, £5; No. 2, £4 15s.; good Honeycomb iron, £4 12s. 6d. You might find it to your interest to try 20 tons of our pigs. We warrant all our iron to be smelted from Welsh ore—free from any mixture of cinders, and our furnaces blown with cold blast. Many of our neighbours are adopting the hot-blast system, but this (as we presume that you have long since observed) to the great deterioration of the strength of the iron. . . ."

Fireproof Conveyor Belting

Recent research into the hazard of fire from belting, particularly in conveying systems, has favoured the treatment of belts by P.V.C. (polyvinyl chloride) as the most adequate deterrent so far known. P.V.C. does not support combustion and is fire-resisting, thus removing the hazard from external fires. It also impregnates the duck and automatically makes it fireproof. Apart from its non-inflammability, P.V.C.-treated belts would appear to withstand abrasion better than rubber belts and do not readily strip or gouge.

Commercial P.V.C. suitable for conveyor belting is a rubber-like plastic and is a compound of polyvinyl chloride and other chemical ingredients introduced as plasticizers, stabilizers, etc. Normally, these are compounded by mixing in a suitable apparatus and processed in a mixer, or in a rubber mill using hot rolls to produce a rough sheet which can be converted into a plastic mass. The material can also be supplied to produce a free-flowing paste that can be spread on a fabric or in the form of a solution for dipping or spreading. The selection of a suitable plasticizer is important, as this in large measure determines the fire-resisting properties of the final compound.

New Space-heating Unit

Adequate interior heating of workshops and buildings is essential to promote maximum comfort for personnel. A novel method of heating with gas-heated air has been designed by the Chandos Engineering Company, Limited, Egham (Surrey), and a recent demonstration suggested that the "Gasanair" system is efficient, economical, and safe. The gas supplied from the mains is first purified in an insulated chamber. Thus, when fed to the lighted jets, it can be mixed with an appropriate air current and carried through ducts with suitably spaced outlets to rarify the general body of the atmosphere within the building with a mixture free from harmful inorganic matter.

Units can be supplied in various sizes, even the largest type taking up little space and capable of being erected at any site. The system is automatic and after igniting does not require further attention. In event of flame failure the gas supply is automatically cut off by thermostatic control.

PROF. NORMAN PIERCY, formerly Professor of Aeronautical Engineering at London University, died last week at the age of 61.

New Catalogues

Refractories.—The Morgan Crucible Company, Limited, of Battersea Church Road, London, S.W.11, have issued a leaflet describing the properties of M.R. plastic mouldable refractory. Ready-mixed, it is delivered in air-tight containers. Neat illustrations in the leaflet show how it is best used, whilst a table gives its composition and mechanical characteristics before and after drying.

Dust Control Units.—This catalogue from Dallow Lambert and Company, Limited, of Spalding Street, Leicester, comes at a propitious time, for the foundry industry is deeply interested in the problems of dust elimination. In the 8-page, well-illustrated, booklet, details of no fewer than 135 different types of units are listed and described. The catalogue is available to readers on writing to Leicester.

Bifurcated Fan Units. A pamphlet received from Keith Blackman, Limited, Mill Mead Road, Tottenham, London, N.17, contains the following phrase: "The main feature of the unit is that the fan casing is split or bifurcated across a diameter and opened out to provide a separate chamber for housing the driving motor, thus isolating it from the fumes passing along the duct which surrounds it." This, of course, makes it specially interesting for departments handling corrosive fumes, such as pickling vats and the like. The pamphlet is available to our readers on writing to Tottenham.

Book Reviews

Mechanical World Year Book, 1953. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 3s. 6d. net.

The special feature of the 1953 edition of this well-known pocket reference book is an article on the design of springs. The main attraction of the book is, however, the data given in the numerous tables.

Lighting in Industry. Published by the British Electrical Development Association, 2, Savoy Hill, London, W.C.2. Price 9s. post free.

The reviewer has always imagined that the first paper on factory lighting given by the officials at Savoy Hill was to the Institute of British Foundrymen and from that time onwards, the foundry industry has, by and large, been enthusiastic on this subject. Because of this, it is thought that a better pair of pictures could have been found for illustrating the present book, yet it must be admitted that the second one does disclose a unique and rather attractive scheme. The first one is just "out of date." The great value of the book however, is that in easily understood language, it discloses how to make a survey of one's shops, and the lessons to be derived from such a study. Lighting is so very important, that this low-priced book should be included in the technical section of every works' library.

SWEDEN exported 15,666,000 metric tons of iron ore in 1952, compared with 14,997,000 tons in 1951.

ADDRESSING members of the Stockton-on-Tees and Thornaby Rotary Club, Mr. S. A. Sadler Forster, chairman of North-Eastern Trading Estates, Limited, Gateshead, proposed the setting up of an export council for the north-east area. He said it was important to see that the achievements and adaptability of north-east industry were kept well to the fore. To this end some form of united action was needed from the Tees, Wear, and Tyne areas and south-west Durham.

Industrial Output Falls in 1952

It is estimated that industrial production in the U.K. in 1952 fell to about 3 per cent. below the level of 1951. This compares with a rise of 3 per cent. in 1951 over the 1950 level, and an annual advance in production of about 8 per cent. between 1948 and 1950. The output index for December is expected by the Central Statistical Office to show a sharp fall from the provisional November level of 121 to 111-112. This would bring the estimate for 1952 as a whole to 113.5, compared with 117.3 for 1951.

Several factors contributed to the decline in production last year, particularly shortages of raw materials and contractions in demand both at home and abroad. Steel shortages continued to hamper the metal-using industries, such as shipbuilding and the motor-vehicle industry, while to some extent new building for manufacturing was also affected. Raw material supply difficulties affected many others.

Output continued to recover during November last year from the low level to which it had fallen in the third quarter. The provisional estimate by the Central Statistical Office of 121 is 3 points above the October index. It is still 2 points below the level of output in November, 1951, however.

Mining and quarrying output, at 116 for November, showed no change either on the month or on the year. There was a small rise in output in November in manufacturing industry, the index gaining 2 points to 122, but it was still about 3 per cent. below the level of November, 1951.

Augmenting Home Scrap Supplies

The guest of honour at the annual dinner of the Cleveland Institution of Engineers, at Stockton-on-Tees, Captain H. Leighton Davies, president of the Iron and Steel Institute, and chairman of the British Iron and Steel Federation scrap committee, suggested that a 6 per cent. scrap yield from the 5,000,000 tons of slag tips throughout the country would remove the necessity of importing scrap, while the collection of all the empty cans would yield another 250,000 tons of scrap annually.

He commended Dorman, Long & Company, Limited, and the Cargo Fleet Iron Company, Limited, for their efforts in recovering scrap from old tips.

Imperial College Expansion

Additional resources to provide for a major expansion of the Imperial College of Science and Technology are to be granted to London University, MR. J. A. BOYD-CARPENTER, Financial Secretary to the Treasury, announced recently. He indicated that there were now some 1,650 full-time students at the college, and it was proposed to increase this number to 3,000 during the academic quinquennium 1957-62. Development of the college would be in pursuance of the Government's policy of building up at least one institution of university rank devoted predominantly to the teaching and study of the various forms of higher technology. The Government proposed to make resources available for developments in other parts of the country.

CLYDE NAVIGATION TRUSTEES have approved a £200,000 scheme for repairs and renewal at Rothesay Dock, Clydebank. The scheme, which is expected to take three years to complete, is being undertaken because of the increased size of ships being handled at the dock due to greater tonnages of iron ore shipped to the Clyde.

New Patents

The following list of patent specifications accepted has been taken from the "Official Journal (Patents)." The numbers given are those under which the Specifications will be printed and all subsequent proceedings will be taken. Applications for copies of the full Specifications (2s. 8d. each, post free) should be made to the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

682,705 FOX & COMPANY, LIMITED, S., BOLSOVER, G. R., BAGNALL, F. T., and WILCOCK, R. Processes for the production of steels of low carbon content.

682,717 SPENCER-BONECOURT, LIMITED. Plant for the recovery of waste heat from furnace gases.

685,391 TRIGGS, W. W. (Dorr Company). Ore jig.

685,484 BROKEN HILL ASSOCIATED SMELTERS PROPRIETARY, LIMITED. Refining metals by distillation.

685,590 FREUDENBERG, H. Production of moulding sand.

685,683 GENERAL ELECTRIC COMPANY, LIMITED, DOVEY, D. M., and HYDE, P. W. Forming alloy layers on metallic surfaces.

685,730 MOND NICKEL COMPANY, LIMITED. Ferrous alloys.

685,789 DORMAN, LONG & COMPANY, LIMITED, FOSTER & COMPANY, LIMITED, H., KENNEDY, F., and GIRLING, W. G. Chequer bricks for blast-furnace stoves or the regenerator chambers of furnaces and coke ovens.

685,797 INDUSTRIAL IMPREGNATIONS, LIMITED. Treatment of defective metal castings.

685,805 DIRECTIE VAN DE STAATSMIJNEN IN LIMBURG. Slag-removing device for use in furnace installations.

685,857 IDOSON MOTOR CYLINDER COMPANY, LIMITED, and TAFT, T. H. Preparing moulds for metal castings, more particularly for air-cooled cylinders.

685,873 JOBBINS, INC., W. F. Aluminium/magnesium casting alloy.

686,033 BABCOCK & WILCOX COMPANY. Continuous casting process and apparatus.

686,085 HUNTER DOUGLAS CORPORATION. Continuous casting.

Increased Production in Latin America

The production of iron and steel has increased rapidly in Latin America since before the war. In 1938, only Brazil, Argentina and Mexico had steel industries, producing annually a total of some 200,000 tons of ingot steel. By 1945, production had risen to over 500,000 tons and by 1951 to about 1,700,000 tons, those States contributing including Brazil, 830,000 tons; Mexico, 450,000 tons; Argentina, 250,000 tons; and Chile, 180,000 tons. Demand, however, has hitherto exceeded supply. Total imports of semi-finished and finished steel rose from 1.6 million tons (ingot equivalent) in 1937 to over 3 million tons last year. The inability of the exporting countries to supply the increased demand in full, especially during the war and post-war rearmament periods, has prompted programmes of expansion in the present producer countries, and plans to start industries in Peru, Venezuela, Colombia and Uruguay. The additional plant at present under construction, or definitely planned, will enable output of steel ingots to rise by over a million tons. This does not take into account the tentative plans of Argentina and Uruguay which may eventually add a further million tons.

A TECHNICAL MISSION to investigate and submit recommendations regarding the size and scope of India's proposed third iron and steel plant is to be appointed by the Indian Government.

Government Losses on Non-ferrous Metal Trading

In his report on the trading accounts and balance-sheets of the Government's trading departments, the Comptroller and Auditor-General states that a provision of £5,376,773 was made by the Ministry of Materials to cover possible losses on stocks where selling price was less than cost during the financial year 1951-52. This sum was mainly to cover losses on non-ferrous metals and jute. Amounts provided to cover losses on lead were £1,250,000, on zinc £302,983, and on copper £425,000.

The Supplementary Civil Estimates recently issued disclose that the net trading deficit of the Ministry of Materials for the financial year 1952-53 is expected to be £42,600,000. Of this sum, £33,248,000 is required by the Ministry for additional expenditure on trading services and for assistance to industry, including a grant-in-aid.

Instead of an anticipated net receipt of just over £14,000,000, the Ministry now finds it necessary to ask for funds of £32,700,000 for trading services in raw materials still subject to Government control—a change-over of £47,000,000. These include a revised estimate of £14,144,000 for copper (original estimate £700,000).

The figures do not represent actual losses or profits, but the change in the cash position. Fluctuations in prices—mainly declines—account for much of the additional expenditure necessary, but changes in stock totals are also important. Variations in general debtor and creditor positions in the materials with suppliers and consumers is a further factor.

The Ministry is seeking a further £20,000,000 to pay for strategic stockpiling of various materials. The total is now £65,300,000, instead of £49,300,000 originally envisaged as covering needs for this purpose. The supplementary estimate of the Export Credits Guarantee Department is £14,818,000, required mainly for additional payments arising from sterling transfer difficulties. The Ministry of Supply has presented supplementary estimates to a total of £47,649,010. Additional sums of £13,600,000 are required in connection with research. There is an additional loan of £2,500,000 for the production of uranium. An additional £6,600,000 is required to assist industry.

Ore Production in Norway

A new sulphur pyrites mine at Skorovas, North Norway, which it is estimated will produce about 150,000 tons a year, has just started production. A cable transporter, 28 miles long, carries the ore from the mine to the shipping terminal. Nearly all the ore is exported.

The Syd-Varanger iron-ore mines near Kirkenes, North Norway, are now producing ore concentrates at the rate of almost 1,000,000 tons a year. Production was resumed this summer and has risen steadily since. The mines were destroyed during the war, and have been rebuilt at a cost of £8,250,000. Nearly all the ore is exported, chiefly to Great Britain and Western Germany.

State Industry Borrowing

Notices issued recently announce Treasury guarantees for temporary borrowings by the Gas Council of not exceeding £60,000,000, by the British Electricity Authority of not exceeding £110,000,000, and by the Iron and Steel Corporation of Great Britain of not exceeding £30,000,000.

Personal

MR. GRANVILLE WALKER, manager of the wagon works of the Butterley Company Limited, has just returned from a business tour of Australia.

MR. ALEXANDER ROSS, a former pupil of Leith Academy and Heriot-Watt College, Edinburgh, has been appointed chief engineer of the American Locomotive Company.

MR. G. A. PARKER, who has been a member of the council of the British Association of Machine Tool Merchants for five years, has been elected president of the association.

THREE DIRECTORS of Simon-Carves, Limited, have been appointed joint managing directors of the company. They are MR. J. P. V. WOOLLAM, MR. D. T. BARRITT, and MR. H. CLARKE.

MR. M. W. THRING, M.A.(CANTAB.), F.INST.F., F.INST.P., has been appointed an assistant director of research of the British Iron and Steel Research Association. He will continue as head of B.I.S.R.A.'s physics department.

MR. J. A. DRAKE, of Keighley Road, Ogden, Halifax, has been appointed president of Halifax and District Engineering Employers' Association, with Mr. H. T. Rutter as senior vice-president, and Mr. J. G. Sagar, junior vice-president.

MR. FREDERICK FRANKS, a director of Geo. Robson & Company (Conveyors), Limited, and Furnival Steel Company, Limited, both of Sheffield, has left on a business trip to South America. He will be returning at the end of March.

KENNETH G. DONALD assumed the position of vice-president and treasurer of National Research Corporation of America from February 1. The position of treasurer was recently made vacant as a result of the resignation of Mr. E. Norman Staub.

MR. H. E. CLIVE, O.B.E., chairman of Marston Excelsior Advisory Board, and MR. J. T. SMITH, a director in charge of engineering, have both retired from the Board of the Metals Division of Imperial Chemical Industries after many years of enlightened service to the group.

FOUR EMPLOYEES of W. H. Dorman & Company, Limited, Stafford, MR. A. LEADBETTER, MR. C. E. DUTTON, MR. A. BINNS, and MR. S. SEAR, received long-service awards for 50 years' service with the firm, presented by Mr. H. F. Smallwood, chairman and managing director.

Shropshire Education Committee has appointed MR. J. MILBOURNE, of C. & W. Walker, Limited, engineers, etc., of Donnington, to be a governor of the Walker Technical College, Oakengates, in the place of MR. H. F. HODGSON, a director of Joseph Sankey & Sons, Limited, metal pressers and stampers, etc., who has resigned.

THE MAYOR-ELECT of Huddersfield is Coun. Wilfrid Mallinson, who has risen from an apprentice moulder in the firm of Henry Brook & Company, Limited, ironfounders and constructional engineers, Huddersfield, to be chairman of the board of directors. He has also several other business connections. His father, who was a director of the firm, insisted on his son starting at the bottom and learning thoroughly every stage of the business. Coun. Mallinson has been Liberal representative of Lockwood Ward on Huddersfield Town Council since 1940. He was until recently president of the West Riding Ironfounders' Association.

Obituary

MR. ELLIS HEMMINGFIELD, for many years a representative of the Albion Works of Thos. W. Ward, Limited, Sheffield, died recently. He was 62.

THE DEATH is announced of MR. A. H. YOUNG, senior executive in the castings department of I. Bier & Son (Iron & Steel), Limited, for many years.

SIR LEOPOLD SAVILE, who was formerly Civil Engineer-in-Chief to the Admiralty, died recently at the age of 82. He was president of the Institution of Civil Engineers in 1940.

THE DEATH OCCURRED on February 3 of MR. ERNEST PARKINSON at the age of 83. Mr. Parkinson was chairman of directors of J. Parkinson & Son (Shipley), Limited, machine-tool makers, Canal Ironworks, Shipley.

THE DEATH has occurred at the age of 79 of MR. SAMUEL PRICE BOWEN, managing director of Cleveland Tar Distillers, Stockton-on-Tees. Mr. Bowen, before starting business on his own account, was blast-furnace manager at the Tees Bridge Iron Works, Stockton-on-Tees.

THE DEATH has occurred of BRIGADIER JAMES STORAR, chairman of Robert Stephenson & Hawthorns, Limited, locomotive builders, of Darlington, and of Vulcan Foundry, Limited, Newton-le-Willows (Lancs). He was a director of Nyasaland Railways, Limited, and other companies.

THE DEATH occurred recently of MR. CHARLES EDWARD BALL, assistant foundry manager of Distington Engineering Company, Limited, Workington (Cumberland). He was splashed with molten metal the previous week when a 40-ton ingot mould exploded as it was being cast. He was 42.

ENGINEER-COMMANDER CHARLES JOHN HAWKES, who has died at the age of 73, was Professor of Engineering at King's College, Newcastle-upon-Tyne, from 1920 to 1946. He was president of the North-East Coast Institution of Engineers and Shipbuilders from 1936 to 1938, and from 1912 to 1914 was joint secretary of the Royal Commission on Fuel and Engines. Later he was secretary of the Board of Invention and Research.

THE DEATH occurred in London last Friday, following an operation, of MR. D. M. HENSHAW, of Huddersfield, at the age of 69. Mr. Henshaw was chairman and joint managing director of W. C. Holmes & Company, Limited, ironfounders, gas and chemical engineers, Turnbridge, Huddersfield. A director since 1916, he was appointed chairman of directors in 1941 in succession to the late Mr. P. F. Holmes. He became the chairman of B.H.D. Engineers, Limited, on its formation, and at the time of his death he was also chairman of Bryan Donkin & Company, Limited, Chesterfield, British Furnaces, Limited, amongst other firms.

BRADLEY FORGE & ENGINEERING COMPANY, LIMITED, Abercorn Brass Foundry, Hilda Road, Canning Town, London, E.16, announce that they have installed extra melting equipment to meet the increasing demand for gravity die-castings.

THE NORTHERN SECTION of the Institute of Vitreous Enamellers have arranged a dinner and social evening to be held on Wednesday, February 18, at the Queen's Hotel, Manchester, at 7 for 7.30 p.m. The cost is 11s. 6d. per member, and application for tickets should be made to the honorary secretary, Mr. T. J. McArthur, the Rustless Iron Company, Limited, Trico Works, Keighley, Yorks.

News in Brief

IT WAS REPORTED that production at Wingets, Limited, Rochester, was temporarily halted when their works was flooded during the recent storms.

THE 57TH annual meeting of the American Foundrymen's Society is to be held at Chicago from May 4 to 8 and tentative arrangements for the session timetable have been announced.

THE DIRECTORS of Hick, Hargreaves & Company, Limited, general engineers, ironfounders, etc., of Bolton, propose to offer 48,000 £1 shares to shareholders, in the proportion of one new share for every six existing shares held, at 52s. 6d. a share.

A MEETING of the Welsh Engineers and Iron Founders' Conciliation Board at Swansea this week to discuss a claim for "a substantial increase" in wages was adjourned with no date fixed for another meeting. Negotiations have been going on since November.

THE ANNUAL AND GENERAL MEETINGS of the Association of Bronze & Brass Founders will be held on Wednesday April 29, 1953, and arrangements will be made for a theatre party on the previous evening. Details of the arrangements will be announced later.

MR. R. R. FYFE SMITH writes us that the article we printed from *Target* on Smith & Wellstood's system of "Merit Rating for Apprentices" was actually inaugurated by Col. Hunter, of Cockburn & Company, Limited, Falkirk, and was practised by that company for many years.

MR. A. E. SELLERS, chairman of Sellers & Company (Huddersfield), Limited, textile engineers, Chapel Hill, Huddersfield, has suggested that every employed person, including executives, should give a day's wage or salary to provide relief for the tremendous distress caused by the floods round the British coast.

THE ROYAL SOCIETY OF ARTS, John Adam Street, Adelphi, London, W.C.2, has announced two Cantor lectures on "The Safety Factor in Construction." The first, on February 23, is by G. Anthony Gardner, O.B.E., and the second, on March 2, by Professor F. C. Thompson, D.Met., M.Sc. Both lectures commence at 6 p.m.

THE STAVELEY COAL & IRON COMPANY, LIMITED, announces the acquisition of a controlling interest in James Archdale & Company, machine tool manufacturers, of Birmingham and Worcester. Mr. Fred, Mr. James and Mr. Will Archdale will continue to be directors and to carry on the executive management of the company.

MR. STANLEY GITTINS, of 22, Waterloo Road, Wolverhampton, has been engaged to represent Catton & Company, Limited, 29, Chadwick Street, Leeds, 10, and will be responsible for the selling of carbon-steel and alloy-steel castings in the counties of Derbyshire, Staffordshire, Shropshire, Warwickshire, Worcestershire and Oxfordshire.

THE RADIAC COMPANY, INC., 489, Fifth Avenue, New York, have developed a self-contained ultra-violet lamp operating on 110 v. a.c. current derived from one 6-v. battery. Apart from obvious mineralogical applications, it is thought this may be suitable for crack-detection work on castings, where mains electricity is not available. The lamp is carried in a small attaché case.

AN APPEAL for more generous financial support by industry, such as had been given in the past, to enable research work to be developed at Birmingham University, and by local authorities for maintenance of extra-mural work, is made by Prof. Humphrey Humphreys, the Vice-Chancellor, in his annual report, which states that to realize the full potential of educational opportunities an extra £80,000 a year will be required.

THE FIRST annual dinner of Incorporated Plant Engineers, held at the Café Royal, Regent Street, London, on January 30, was attended by approximately 150 members and guests, among whom were included Sir Norman Kipping, J.P., director general, Federation of British Industries; Mr. W. L. Boon, O.B.E., Powell Duffryn Technical Services, and Mr. A. Clifford Hartley, C.B.E., F.C.G.I., B.Sc., past-president of the Institution of Mechanical Engineers.

ON APRIL 9 the Shipley branch of the Metal Box Company, Limited, engineers, Wrose Brow Works, Windhill, Shipley, will celebrate its centenary, the date of the centenary being taken from the earliest cash book, although there is actually a wages book for the year 1846 in existence. Since the original firm of Lee & Crabtree, Limited, was taken over in 1930 by the Metal Box Company, Limited, it has been much developed and has become one of the most important engineering works in the district.

A BRONZE GROUP of the bearer party at King George VI's funeral has been cast at the Morris Singer art foundry and will be exhibited at Hope House, Great Peter Street, London, from February 16 to March 1. Entitled "*Ave Atque Vale,*" the group is over 2 ft. long and 18 in. high and the artist is Reginald Gunther, who took 11 months to prepare the model. Also at the Morris Singer foundry, "Eros," the aluminium statue from Piccadilly Circus, is being cleaned as part of the refurbishing of London preparatory to the Coronation.

APPROXIMATELY 250 Black Country firms, some of them foundries, and all members of the Dudley branch of the National Union of Manufacturers, are to be asked for their views on a suggestion that small firms should co-operate closely to increase export trade without heavy overhead costs. Two schemes are being proposed. One concerns firms insufficiently large to set up export agencies but making the same article. These firms might, it is suggested, employ the same agency. The second scheme is for firms producing component parts who might, it is proposed, arrange to market a finished product by one of the firms taking over assembly. The chairman of the Dudley branch, who is an enthusiast for the scheme, is Mr. Gilbert Salter.

DUE TO the recent flooding, the Erith works of British Insulated Callender's Cables, Limited, was flooded and temporarily put out of action. The works are situated on flat ground alongside the river Thames and the inundation was caused by breaches of the river bank in two places at 1.10 a.m. on February 1. Both gaps were filled with sandbags during Sunday with the assistance of approximately 1,000 workpeople and staff who had turned out to help. One of these repaired gaps was breached again during the following night and five new gaps were made in the river embankment wall, with the result that the works were completely flooded, there being a maximum of 6 feet of water in places. Fortunately, at the time of the flooding only a few workpeople were in the factory, and there were no casualties of any kind. B.I.C.C. are fortunate in having four main factories; wherever possible, therefore, orders booked for the Erith factory are being diverted to Prescot and elsewhere, and every effort is being made to restore output at Erith.

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Raw Material Markets

Iron and Steel

Prices of iron and steel scrap are raised by amounts ranging from 11d. to 1s. 11d. per ton under an Order which came into operation yesterday (Wednesday). The changes are to allow for the recent rise in transport charges. Under a second Order, which also came into operation yesterday, maximum prices of certain grades of foundry pig-iron and of one or two semi-finished and finished steel products are raised by varying amounts.

Common foundry iron for delivery in the Middlesbrough area has been raised by 6s. 6d. per ton, and for Birmingham delivery by 6s. Low-phosphorous foundry iron, Scotch No. 3 foundry iron, cylinder and refined iron, and refined malleable iron are also dearer. The changes are reflected in the price-list, which appears on page 32.

Fresh business for castings shows no appreciable increase, and some foundries find it difficult to maintain operations, although many of them are on a four-day working week. Although there has recently been a larger circulation of inquiries, these have not yet been translated into actual business. Buyers of castings are reluctant to purchase supplies outside those needed immediately, with the result that quantity bookings for forward delivery are small and there is keen competition for any new business which arises. Most foundries are striving to keep their plants operating and to avoid further suspension of labour. In the case of the light foundries providing castings for gas cookers, heating apparatus, and other household equipment, the stocks of these articles at the warehouses continue to slow down new business.

Although licensed tonnages of pig-iron are on a reduced scale, some of the light and jobbing foundries are not taking up their full quotas, and demands on the furnaces for high-phosphorus pig-iron are limited to the amount of work on hand. Producers, with the increased outputs now being obtained from three new furnaces recently blown in, are able to fulfil present demands with little difficulty, and will continue to do so if production of this grade of pig-iron is kept at present levels; the possibility, however, exists that the increasing demands of the steel trade will enforce a change over to the production of basic pig-iron by one or more of these furnaces.

The engineering and speciality foundries show varying degrees of activity. Those producing castings for the trades closely connected with the export markets are finding business slack, while those supplying castings for some home trades, including steelworks and collieries, have far more work. The supply of the low- and medium-phosphorus irons, which have not been on a scale to provide adequately for the foundries when fully engaged, are now more in keeping with requirements, but even with the reduced demands there is little to spare. Hematite pig-iron is scarce, and although outputs have increased recently, the demands from both steelworks and foundries are heavier than available tonnages. The expected changing over of a furnace on the North-east Coast from the production of this grade to basic-steel making iron will increase the supply difficulties of the foundries. It is reported that to relieve the position the control is allocating supplies of imported hematite.

With more than a month of the present period gone, makers of finished steel are still working on the reduction of the backlog from Period IV, with the result that the tonnage accepted for Period II is far below what consumers anticipated. So far no maker has opened his books for Period III.

Non-ferrous Metals

At the same time as the President's announcement that wages control was to end in the United States came the news that restrictions on tin had been revoked. The administrator of the National Production Authority stated that this action was made possible "by the present and foreseeable U.S. tin position." This change of heart means that tin can be sold freely at any price in the States and used for any purpose. Stocks may be accumulated if desired, but it is not anticipated that this changed pattern will interfere with the Government's stockpiling plans. U.S. consumers and dealers must, however, continue to submit monthly reports of their stocks and transactions.

In London last week the metal showed strength in the cash position, which advanced by £12 to £979. Three months was up by only £1 to £948, the backwardation being £31 at the end of the week. Stocks in L.M.E. warehouses have been declining during the past few weeks and have now reached a decidedly low level.

In the lead market the premium for February metal was reduced to £2 5s. by the end of the week, but on balance both positions closed higher. Owing to the Australian strike there is something of a squeeze for the current month. In the States there was a reduction of ½ cent in the price to 13½ cents per lb. Zinc, too, suffered a setback in America, also of ½ cent, from 12 cents to 11½ cents per lb. In Whittington Avenue, however, the second half of the week saw a firmer tone, after it had appeared as though the quotation would drop to £80. It was reported that influential support was being given to the market, which closed, nevertheless, £1 lower for February and 17s. 6d. down for May. The recovery seemed to be in the nature of a technical rally and it is doubtful whether the advance will go very far, for demand for zinc in the U.K. is far from good. Supplies, too, are now adequate and there is no question of a squeeze as in the case of lead.

In copper it is reported that at least one large producer in the States is now selling only on the basis of the date of shipment. The suspension of the 20 cents import duty is now assured as the Senate has approved the Bill for a further period. From Chile comes the news that the Central Bank will control all copper sales for a further three months, but nothing fresh has been heard of the Government's intention to increase the selling price of the metal by 3 cents per lb. In some quarters this is regarded as "kite flying."

Official prices of refined pig-lead:—

February—February 5, £95 10s. to £96; February 6, £97 to £97 10s.; February 9, £95 10s. to £96; February 10, £94 10s. to £95; February 11, £94 to £94 5s.

May—February 5, £93 to £93 10s.; February 6, £94 to £95; February 9, £93 5s. to £93 10s.; February 10, £92 10s. to £93; February 11, £93 to £93 5s.

Zinc official quotations:—

February—February 5, £83 to £83 5s.; February 6, £84 2s. 6d. to £84 7s. 6d.; February 9, £83 to £83 5s.; February 10, £82 5s. to £82 10s.; February 11, £82 7s. 6d. to £82 12s. 6d.

May—February 5, £83 10s. to £83 12s. 6d.; February 6, £84 7s. 6d. to £84 12s. 6d.; February 9, £83 5s. to £83 10s.; February 10, £82 10s. to £82 12s. 6d.; February 11, £82 10s. to £82 12s. 6d.

The following official tin prices were recorded:—

Cash—February 5, £974 to £976; February 6, £978 to £979; February 9, £978 to £980; February 10, £972 to £975; February 11, £968 to £970.

Three Months—February 5, £948 to £949; February 6, £948 to £950; February 9, £945 to £947; February 10, £942 to £944; February 11, £941 to £942.